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ABSTRACT

Eight issues of this research journal on gifted children include the following topics: (1) Profile of a Gifted Child: The Johns Hopkins Program for Mathematically Precocious Youth--Fall 1986; (2) The Impact of the Arts on Our Civilization: Excerpts from Colloquium III (Louisville, Kentucky)--Summer 1987; (3) Why Are Asians so Smart? An Evolutionary Approach--Winter 1988; (4) Why Are Asians so Smart--Part II--Commentary on "The Intelligence of the Mongoloids: A Psychometric, Evolutionary and Neurological Theory" by Richard Lynn--Summer 1988; (5) Terry Tao: Education for the Gifted in Egalitarian Australia and Winners of the MERF Awards for Excellence--Fall 1988; (6) Science and Society: Our Critical Challenges; Proceedings of Colloquium IV (Austin, Texas)--Spring 1989; (7) (Focus on Kazimierz Dabrowski, Psychiatrist)--Fall 1989; (8) Mentors: Did You Have One? Could You Be One? and Gifted and Handicapped: Not an Oxymoron--Spring 1990. (AA)

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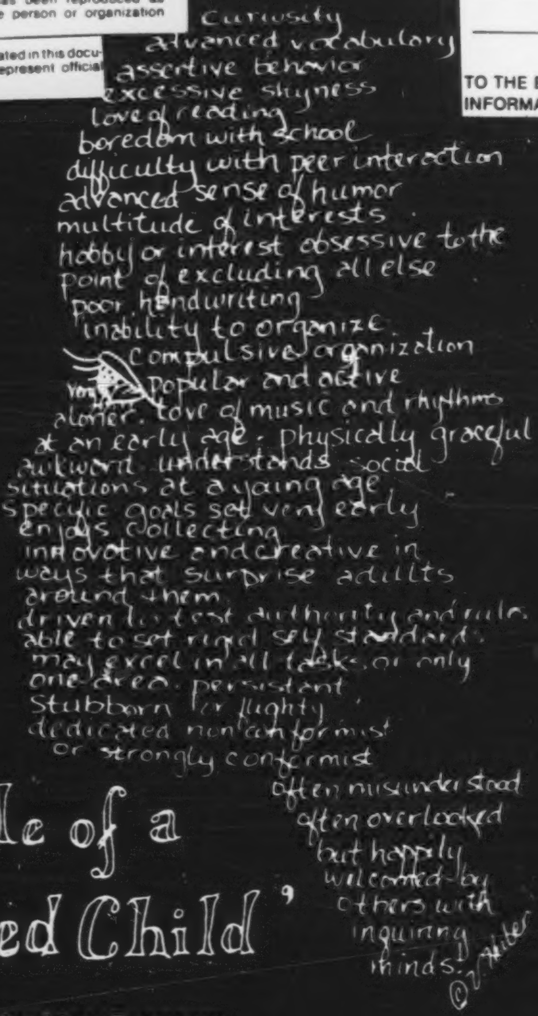

curiosity
advanced vocabulary
assertive behavior
excessive shyness
love of reading
boredom with school
difficulty with peer interaction
advanced sense of humor
multitude of interests
hobby or interest obsessive to the
point of excluding all else
poor handwriting
inability to organize
compulsive organization
very popular and active
loner. love of music and rhythms
at an early age. physically graceful
awkward. understands social
situations at a young age
specific goals set very early
enjoys collecting
innovative and creative in
ways that surprise adults
around them
driven to test authority and rules
able to set rigid self standards
may excel in all tasks, or only
one area. persistent
stubborn or flighty
dedicated nonconformist
or strongly conformist
often misunderstood
often overlooked
but happily
welcomed by
others with
inquiring
minds!

EC 232 651

# 'Profile of a Gifted Child'

The Johns Hopkins Program
for Mathematically Precocious Youth

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# MENSA 21.
## RESEARCH JOURNAL

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**Staff:**

*Editor* • Phyllis Miller, 23 Lexington Road, Somerset, NJ 08873

*Production Assistant* • Carrie Martin, 2284 Pressler Road, Akron, Ohio 44312

*Circulation Manager* • Alan Blair, 20 Linden Lane, Plainsboro, NJ 08536

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# Editor's Preface

Do you have a child who was not accepted into first grade at the age of $5\frac{1}{2}$ even though he had taught himself reading, addition, subtraction, multiplication, division, negative numbers and fractions by the time he was 4, because he couldn't tie his shoelaces and therefore showed a lack of emotional maturity? I do. Now he is 16, and is smart enough to tie the shoelaces on his soccer, basketball and tennis shoes, and wear loafers the rest of the time.

If I had read this issue of the *Mensa Research Journal* 11 years ago, I would have faced the teachers with greater resolve. To all of us who know a gifted child or were one, this special issue of the *Journal* will be exciting to read. The articles are written by Julian C. Stanley and Camilla P. Benbow, directors of the Study of Mathematically Precocious Youth (SMPY) at Johns Hopkins University and Iowa State University, respectively, and Dr. Benbow's colleague, Robert Benbow, with a special introduction by Dr. Stanley. They describe SMPY and many of the research findings that have grown out of it, but they do more: they talk about gifted young people in a caring, positive way all too rare in our society today. And they reinforce what we always knew intuitively, despite what the teacher said.

As the new editor of the *Mensa Research Journal*, I'm delighted to be able to bring these articles to you. Most of them have been reprinted from other scholarly journals; all of them were winners in the Mensa Education and Research Foundation competition for excellence in research on intelligence. Unlike most other researchers, the authors are clearly biased in favor of their subjects, gifted children.

Perhaps you'd like to give an extra copy of this issue to your gifted child's teacher for Christmas!

Phyllis Miller, *Editor*

*Introduction*

# The Study of Mathematically Precocious Youth (SMPY)

I started SMPY at Johns Hopkins University in 1971. Begun with a five-year $266,100 grant from the newly founded Spencer Foundation of Chicago, it continues to the present with two divisions, "SMPY at JHU" and "SMPY at ISU" (Iowa State University). The director of the latter is Dr. Camilla P. Benbow, an associate professor of psychology at ISU who worked with SMPY at JHU from 1977 until 1986.

SMPY was begun to find youths who *reason* exceptionally well mathematically and help them move ahead faster and more effectively in mathematics and related subjects than would usually be possible in their school systems. Chiefly, 12-year-old boys and girls take the College Board Scholastic Aptitude Test (SAT) in a regular national testing session near the end of January when they are seventh graders. There are two minimum qualifying scores on the mathematical part of the SAT (SAT-M): 500 before age 13, and 700 before age 13. Scorers in the 500–800 range are approximately the ablest 1 percent of their age group with respect to mathematical reasoning ability. The latter (700–800 range) are approximately the ablest 1/100th of 1 percent. By comparison, 52 percent of college-bound, male high-school seniors and 35 percent of such females score 500 or more. For 700 or more, the respective percents are 6 and 2. Of course, the seniors are about five years older than the seventh graders and have studied far more mathematics.

These mathematically precocious youths are found in order to be helped. In some 10 books, more than a hundred professional articles and a long-continued newsletter, many conferences, much correspondence, and many telephone conversations, the staff of SMPY has tried to influence the educational lives of its "protégés." For a venture that began only 15 years ago, it has been highly successful. During the summer of 1986, for example, the following events occurred:

1. Four of the six members of the U.S. team in the International Mathematical Olympiad (IMO), held in Warsaw, were members of SMPY's "700–800 on SAT-M Before Age 13" group. They came from about 250 persons in that group who, by still being in high school, were eligible. The other two members of the IMO team were drawn from at least six million eligibles—namely, high school students throughout the nation. One of SMPY's 700M group was, at age 16, on the team for the fourth time. The U.S. team tied Russia for first place among the 37 nations competing. SMPY's four won two gold and two silver medals. Also, one of them (Joseph Keane of Pittsburgh) received the only *special* award given to any participant in this IMO.
2. The 10-year-old (!) member of the Australian IMO team had been

facilitated by SMPY since age 8, when he scored 760 on SAT-M. He won a bronze medal. Australia ranked 15th among the 37 nations competing. No one else on the Australian team won more than a bronze medal, and half of all participants in the IMO won no medal.

3. Two of the five members of the first U.S. team ever entered in the International Physics Olympiad were from SMPY's 700M group.

4. So was one of the four on the U.S. team for the International Chemistry Olympiad. In 1985, two of the four were from the group.

5. Thirteen of the 55 Americans participating in the Research (formerly, Rickover) Science Institute's six-week session were from the group. In 1985, 20 were.

6. Twenty-six of the 65 participants in Professor Arnold E. Ross's famed eight-week institute on "pure" mathematics for high school students, held at The Ohio State University, were from the group. In 1985, 14 of the 43 were.

This listing of outstanding participations and accomplishments during the summer of 1986 could go on and on. Most members of the "700–800 on SAT-M Before Age 13" group did something educationally far out of the ordinary, probably to a large extent because SMPY made them cognizant of their abilities and gave them information about how to use them.

The papers in this issue explore aspects of talent identification and educational facilitation. Persons interested in the annual verbal and mathematical talent searches among seventh graders, utilizing SAT-Verbal and SAT-M, should write or call the following centers:

Northeast, Far West, Alaska, Hawaii, and Western Canada: Center for the Advancement of Academically Talented Youth (CTY), Johns Hopkins University, 2933 N. Charles Street, Baltimore, MD 21218, telephone (301) 338-8427.

Southeast, Southwest, Iowa, and Nebraska: Talent Identification Program (TIP), West Duke Building, Duke University, Durham, NC 27708, telephone (919) 684-3847.

Middle West, except Iowa and Nebraska: Center for Talent Development, Northwestern University, 2003 Sheridan Road, Evanston, IL 60201, telephone (312) 491-3782.

Rocky Mountain States: Rocky Mountain Talent Search, Bureau of Educational Services, University of Denver, Denver, CO 80208, telephone (303) 871-2982.

For special facilitation of females who reason extremely well mathematically, in the 640–690 range before age 13, contact Dr. Linda E. Brody, Assistant Director, SMPY at JHU, 30 Shriver Hall, Johns Hopkins University, Baltimore, MD 21218, telephone (301) 338-7087.

Most of the longitudinal following up of mathematically precocious youth is being done by Professor Camilla P. Benbow, Director, SMPY at ISU, Department of Psychology, Iowa State University, Ames, Iowa 50011, telephone (515) 294-0285.

All of these groups welcome your inquiries, comments, and suggestions. Of course, your bright children, grandchildren, or siblings should become involved. Quite a few 12-year-olds can score high enough on the SAT for membership in Mensa!

Dr. Julian C. Stanley
Director of SMPY at JHU
30 Shriver Hall
Johns Hopkins University
Baltimore, Maryland 21218
Telephone (301) 338-7087

# Youths Who Reason Exceptionally Well Mathematically*

*Julian C. Stanley and Camilla Persson Benbow*

The topic of this volume is conceptions of giftedness. It is somewhat anomalous that the present chapter is included in such a volume. The Study of Mathematically Precocious Youth (SMPY) is not concerned much with conceptualizing giftedness. Obviously, many children are clearly talented intellectually and need educational assistance. SMPY concentrates its efforts on helping such youths and devising novel educational alternatives for them. Thus, its staff has not spent much time contemplating the psychological underpinnings of giftedness. This necessitates our taking a different emphasis than in other chapters of this volume. We shall first describe our operational definition of mathematical giftedness and its meaning. Then we shall outline the rationale of our program.

The following quotation illustrates SMPY's position well:

> What is particularly striking here is how little that is distinctly psychological seems involved in SMPY, and yet how very fruitful SMPY appears to be. It is as if trying to be psychological throws us off the course and into a mire of abstract dispositions that help little in facilitating students' demonstrable talents. What seems most successful for helping students is what stays closest to the competencies one directly cares about: in the case of SMPY, for example, finding students who are very good at math and arranging the environment to help them learn it as well as possible. One would expect analogous prescriptions to be of benefit for fostering talent at writing, music, art, and any other competencies that can be specified in product or performance terms. But all this in fact is not unpsychological; it simply is different psychology (Wallach, 1978, p. 617)

## WHAT IS MATHEMATICAL PRECOCITY?

SMPY's indicator of mathematical talent is simply a high score at an early age on the mathematics section of the College Board's Scholastic Aptitude Test (SAT-M). This may appear narrow. We feel, however, that its elegance lies in its simplicity and objectivity. Moreover, few would argue that such ability does not indicate a high level of cognitive functioning. Although some students may be missed by this criterion, we identify more youths who *reason* exceptionally well mathematically than we can handle.

SAT-M, the major instrument of the Johns Hopkins Talent Searches, was designed for above-average high school juniors and seniors to

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*This revision and extension of Stanley (1977) appears as a chapter in *Conceptions of Giftedness*, Robert J. Sternberg and Janet E. Davidson, eds.; Cambridge University Press 1986.

measure their mathematical reasoning ability (Donlon & Angoff, 1971). We, however, use it mainly to test seventh-graders, who are approximately five years younger. We call them talent search participants. Few of these students have received formal opportunities to develop their abilities in algebra and beyond (Benbow & Stanley, 1982a, 1982b, 1983d). For example, we have found that among the top 10 percent of our talent search participants (i.e., those eligible for our fast-paced summer programs in mathematics), a majority do not know even first-year algebra well. Thus, they must begin their mathematics studies with Algebra 1.

Therefore, these students are demonstrably unfamiliar with mathematics from algebra onward. Yet many of them are able to score highly on a difficult test of mathematical reasoning ability. Presumably, this could occur only by the use of extraordinary ability at the "analysis" level of Bloom's (1956) taxonomy. Thus, we previously concluded that the SAT-M must function far more at an analytic reasoning level for the talent search participants than it does for high school juniors and seniors (Benbow & Stanley, 1981, 1983d).

Although it is not yet well known how precocious mathematical reasoning ability relates to "mathematical reasoning ability" in adults, SMPY has a procedure any researcher can reproduce (many have) and enables selection of populations with high tested ability. Criticisms of whether we are measuring "true" mathematical reasoning ability are at present beside the point. If a test can predict achievement in specific aspects of later life fairly well, it is of value regardless of the precise nature of the ability measured. If the test does predict high achievement, then we may want to establish exactly what it measures or what mathematical reasoning ability may be. SMPY's purpose is in part to determine the predictive validity of the SAT-M. Our work to date indicates that it does predict relevant criteria (e.g., Benbow & Stanley, 1983a).

Finally, SMPY has sought already evident ability, rather than some presumed underlying potential that has not yet become manifest. Thus, we have not worried about late bloomers. As a matter of fact, we are not convinced that many late bloomers in terms of ability exist. It is possible but unlikely to find a student whose SAT scores jump greatly in one year, for example, over 200 points more than other students his or her age. We at SMPY feel that late bloomers are usually the result of early lack of motivation or test sophistication rather than of ability. In order to prevent late blooming or no blooming at all among the mathematically gifted, one of the authors (Stanley) founded SMPY.

## WHY MATHEMATICAL REASONING ABILITY

Persons often ask why we chose mathematical reasoning ability rather than something else, or even why we decided to concentrate on one type of talent rather than studying all sorts. The answer is that we wanted to steer a careful course between excessive specialism and overly broad coverage.

Sharply limited resources made this decision inevitable. Even for the first two years after the study was funded by the Spencer Foundation in 1971, it did not have a single full-time worker. After that there was just one. Small wonder that we did not also select initially for other talents such as verbal reasoning ability, athletic prowess, musical talent, and leadership potential! No matter how hard we might work, relatively little could be done by us for that varied a group.

Given the need to specialize, it seemed sensible to choose an ability closely related to major subjects in the academic curricula of schools in the United States. Because we planned to help intellectually talented youths improve their education, it also appeared wise to start at as early a grade and age level as the maturation of the chosen ability permitted. Moreover, in order to capitalize on the precocious development of this ability by greatly accelerating school progress in the subject matter area concerned, it was necessary to choose school subjects much more highly dependent for their mastery on manifest intellectual talent than on chronological age and the associated life experiences. These considerations led to our choosing mathematical reasoning as the ability and the best of the standard courses in mathematics, the mathematical sciences, and the sciences as the subjects on which to focus directly. We did not want to develop curricula in mathematics, but instead wanted to help mathematically talented boys and girls use their abilities more effectively in the various academic areas. We encouraged curricular flexibility by schools (e.g., Benbow & Stanley, 1983b, 1983c; Stanley & Benbow, 1982, 1983).

We were aided in this choice by more than just armchair considerations. Great precocity in mathematics and the physical sciences has been documented by such writers as Cox (1926) in the second volume of Terman's *Genetic Studies of Genius* series,[1] Bell (1937), Roe (1951), Lehman (1953), Kramer (1974), and Zuckerman (1977). The only clear competitor was musical composition, where the almost unbelievably early accomplishments of Saint Saëns, Mozart, and Mendelssohn are well known (e.g., see Schonberg, 1970). This ability does not articulate well with school curricula, however, nor do we have the knowledge or facilities to nurture young composers. We eliminated chess because it is not an academic discipline.

## WHY IQ SCORES ARE NOT USED

This may be the place to decry what we at SMPY perceive to be vast overemphasis on the Stanford-Binet or Wechsler-type overall IQ in planning academic experiences for brilliant children. If one takes a group of students who all have exactly the same Stanford-Binet IQ (say, 140), one does not have a group homogeneous with respect to such special abilities as mathematical reasoning. The IQ is a global composite, perhaps the best *single* index of general learning rate. One can, however, earn a certain IQ in a variety of ways, for example, by scoring high on memory but much lower on reasoning, or vice versa. *It is illogical and* *inefficient to group students for instruction in mathematics mainly on the basis of overall mental age or IQ.* Often this is done and students who lag behind in the class are accused of not being well motivated, when in fact they simply do not have as high an aptitude for learning mathematics as some in the class who have the same IQ. These considerations also apply to other academic subjects, such as history or English literature.

It is difficult to form a group of students really homogeneous for instruction in a given subject even when one uses all the psychometric and other knowledge about them that can be gathered. To rely primarily on the IQ for this purpose, as do quite a few city and state programs for intellectually talented youths, seems curious. An obvious corollary is that students should be grouped for instruction separately for each subject and that these groupings should be free to change from year to year. Administrative or political convenience is the probable cause of undue reliance on a single grouping measure such as IQ. Now that computer scheduling is available, however, this justification for an ineffective process is weakened.

## WHY SAT-M SCORE IS THE INITIAL CRITERION

We wanted to find youths who at an early age (mostly 12 or 13) were already able to *reason* extremely well with simple mathematical facts, students who even before taking or completing the first year of algebra would reason mathematically better than the average college-bound male 12th-grader does. (Performance is compared against college-bound male 12th-graders because that is the College Board's most stringent norm group.) It seemed to us likely that a reasoning test would predict success in later mathematics, at least through differential equations, far better than would items measuring learned concepts, learned algorithms, and computational speed and accuracy.

We also needed a mathematical reasoning test difficult enough that our average examinee would at age 12 score on it halfway between a chance score and a perfect score. Also, the test should have enough "ceiling" so that virtually no perfect scores would occur.

In addition to the considerations of reasoning content and appropriate difficulty, we wanted a professionally prepared, carefully standardized, reliable test for which several well-guarded ("secure") forms existed and for which well-known, meaningful interpretations of scores were available. High scores on the test should command immediate attention and respect at both the high school and college levels.

These considerations led to pilot studies of the SAT-M, which required only a little knowledge of algebra and geometry.[2] To ensure that testees were given equal opportunity to score well on it, however, we gave them plenty of practice materials. Because reasoning mathematically involves knowledge of some elementary mathematics, this was essential in order to smooth out partially differences in mathematical training. We did not want scores to depend much on rote knowledge of mathematical concepts or on computational ability, as the usual test of mathematical skills does.

In 1969 our first examinee, an obviously brilliant 13-year-old eighth-grader, scored 669 on SAT-M, the 91st percentile of college-bound male 12th graders. On the verbal part of SAT (SAT-V), he scored 590, the same percentile of the same norm group. Another 13-year-old eighth-grader, on whom we tried the test the next year, scored 716 on M and 608 on V. Others scored similarly, some even higher. Extremely few scored near the perfect score on M or even close to the maximum on V. It seemed likely, then, that SAT-M would be excellent for identifying the level of mathematical reasoning ability we sought among seventh and eighth graders. SAT-V could provide additional assessment of overall mental age.as well as level of verbal reasoning ability.

As has been shown in several publications, especially Stanley et al. (1974) and Keating (1976), for the students we tested in our talent searches (i.e., generally the top 3 percent on the mathematics part of standardized achievement tests administered by the students' schools), SAT-M and SAT-V did indeed prove suitable in both content and difficulty. The mean score on each test was appropriately between the chance- and perfect-score levels. The highest scores were almost never perfect.

It would be rare, indeed, for a person to have excellent mathematical *reasoning* ability and yet be inferior to average thinkers in verbal *reasoning* ability. SMPY did not want to identify mere calculating freaks (Barlow, 1952; Smith, 1984). Though its participants are not chosen explicitly for high IQ, virtually none of them seems to have average or below-average IQs.

Students who made high scores on the SAT-M (e.g., 500 or more) in one of our six talent searches conducted between 1972 and 1979 were considered mathematically precocious. A score of 500 is the 51st percentile of male college-bound 12th-graders. Our programs were directed at these boys and girls, who are estimated to reason better mathematically than 99 percent of their age-mates.

Whenever one uses a test and has a fixed point above which the examinee is considered "successful," however, the issue of false positives and false negatives arises. Some examinees whose true ability is right at the criterion will have a good day and equal or exceed it, whereas others will have a bad day and score somewhat below it. On another occasion the situation would have been reversed. (About two-thirds whose true ability is exactly the criterial score, 500, would be expected to score not more than approximately 30 points above or below it, i.e., 470–530.) Thus, we developed a safeguard against false negatives: Whereas the talent-search SAT is taken in January of the seventh grade, examinees who miss the criterion may retake the test on their own in later months to qualify for programs.

False positives are less of a concern than false negatives. The fallacious addition of even as much as 30 points to their score (e.g., 500 when the true score is 470) may give examinees a slightly exaggerated view of their precocity and therefore a higher, but not unattainable, standard of achieving.

## WHY IDENTIFICATION BEGAN AT THE JUNIOR HIGH SCHOOL LEVEL

Elementary mathematics is, from the standpoint of the learner, heavily an algorithmic and deductive system, though for those who create it there are usually strong intuitive and aesthetic elements (e.g., Hardy, 1969; Polya, 1973). Unlike understanding philosophy or great novels such as Tolstoy's *War and Peace,* personal experience outside the classroom and maturation closely tied to chronological age seem not essential for learning mathematics well. Certain types of reasoning ability and Piagetian formal-operations status, however, are necessary for mastering subjects such as high school algebra. These develop in various individuals at vastly different ages.

A startling example will illustrate that young students can develop advanced thought processes at an early age. At age 10, one of SMPY's participants made the highest grade in a state college introductory computer science course. He was competing with seven other exceptionally able, older students and 12 adults. Before his 11th birthday, he had completed at Johns Hopkins most of a second-level computer course, on which he earned a final grade of A. At age 11 he earned, by a score of 4 on the BC level of the Advanced Placement Program examination, credit for two semesters of calculus at Johns Hopkins. This is no ordinary boy, of course. His Stanford-Binet IQ at age 8 was 190, and he had been in our special fast-mathematics classes for two years. He graduated from Johns Hopkins at age 18 in 1982, Phi Beta Kappa. Currently, he is the top student in a major law school. He is not, however, nearly the most precocious youth we have discovered.[3]

Thus, SMPY's extensive experience and the studies by Keating (1975) and Keating and Schaefer (1975) indicated that the intellectually top 2 percent of students in the fifth grade have the necessary abilities sufficiently developed to learn Algebra II and other precalculus courses well. Extremely few could suitably begin studying these before the fifth grade. Because algebra is not usually offered until junior high school, however, the seventh grade seemed a practicable point to start.

Another reason for beginning identification in the seventh grade is that many able students can learn precalculus mathematics *far* more quickly than schools ordinarily permit. The first year of algebra usually causes serious motivational problems for such youths. Regardless of how advanced their ability is, seldom are they permitted to take this subject before the eighth or ninth grades. Then, no matter how much Algebra I the student can already do or how quickly he or she could learn the material, the student is usually lock-stepped into at least 180 class periods throughout the school year. Mathematically highly precocious youths need vastly less exposure than that to what is for them an extremely easy subject. This is especially true when the student has already had one or more years of "modern" mathematics that may have included much algebra covertly. Several dramatic examples from our experience will illustrate the mathematically talented youth's dilemma.

A 12-year-old seventh grader who scored 760 on SAT-M in SMPY's 1974 talent search asked permission to join his junior high school's eighth-grade Algebra I class in February. This request was refused on the grounds that he already had missed more than half the course. He insisted on being given a standardized test covering the first year of the subject. On this he made a perfect score, 40 right in forty minutes, which is 2 points above the 99.5th percentile of national norms for ninth-grade students who have been in that type of class all year. On seeing this achievement, the teacher agreed with the boy that he was indeed ready to join the class! Instead, he took a college mathematics course that summer and easily earned a grade of A. As a high school senior, he represented the United States well in the International Mathematical Olympiad contest.

At the end of the sixth grade a student took second-year algebra in summer school without having had first-year algebra; his final grade was A. By the end of the eighth grade he had earned credit by examination for two semesters of college calculus. A year later he had completed third-semester calculus by correspondence from a major university, earning A as his final grade. At age 21 he graduated from a top university with majors in mathematics, physics, and humanities.

A student learned two and one-half years of algebra well by being tutored while in the fifth and sixth grades. He continued, by means of tutoring, with a high-level course in geometry. His tutor in geometry was a 16-year-old freshman at Johns Hopkins who enrolled for honors advanced calculus (final grade, A) and other subjects that most 19-year-olds would find extremely difficult. He, too, condensed his mathematics radically.

A 6-year-old boy in California mastered two years of high school algebra. At age 7 he enrolled in a standard high school geometry course but found it too slow-paced and therefore finished the book on his own before Christmas. He also taught himself trigonometry. Before age $7\frac{1}{2}$ he had scored at the 99th percentile on standardized tests of Algebra I–III, geometry, and trigonometry. His SAT-M score at age 7 was 670, the 91st percentile of college-bound male high school seniors.

An 8-year-old boy in Australia scored 760 (the 99th percentile) on SAT-M, even though he was unaccustomed to taking multiple-choice tests.

Several girls have accelerated their progress in mathematics considerably, though not as much as the boys just discussed. One of them graduated from high school a year early while being the best student in SMPY's second high-level college calculus class. She went on to earn a bachelor's degree in computer engineering from an outstanding university and then a master's degree in computer science and a Master of Business Administration degree.

Many other such examples could be given (e.g., see Stanley, 1974, 1976a-f) to show that the usual high school pace in Algebra I-III, geometry, trigonometry, analytic geometry, and calculus is far from optimum for boys and girls who reason extremely well mathematically. Algebra I is particularly virulent, because being incarcerated in it for a whole year gives the apt student no really appropriate way to behave. He or she can daydream, be excessively meticulous in order to get perfect grades, harass the teacher, show off knowledge arrogantly in the class, or be truant. There is, however, no *suitable* way to while away the class hours when one already knows much of the material and can learn the rest almost instantaneously as it is first presented. Boredom, frustration, and habits of gross inattention are almost sure to result. Therefore, SMPY identifies youths before they begin their precalculus training, and attempts to intervene educationally.

We are amazed that even more youths do not sustain obvious academic injury, and suspect that the actual damage is far greater than it seems. At least, it appears uncomfortably likely that motivation for mathematics may suffer appreciably in all but those few students devoted to the subject. After such snail-pacing in high school precalculus and calculus—often five and one-half years or more—the number of top minds still excited by mathematics or its applications may be few.

For these reasons SMPY conducted its first three annual mathematics talent searches (1972–1974) among seventh- and eighth-graders, but also did special work among sixth-graders and a few students even younger than that. Beginning in December 1976 the SMPY staff specialized even further to identify only seventh-graders. In SMPY's talent searches, students who were already known to be in the top 3 percent in mathematical ability on standardized achievement tests administered by their schools applied and participated by taking the SAT. The talent searches initially surveyed only the Greater Baltimore area. They then grew. Since 1979 the Johns Hopkins Center for the Advancement of Academically Talented Youth (CTY) annually surveys the entire Northeast and the Middle Atlantic states, from Virginia through Maine. CTY's western talent search encompasses Alaska, California, Hawaii, Oregon, Washington, and western Canada.[4]

Students whose mathematical reasoning abilities proved to be superb were encouraged to move fast through the high school mathematics sequence, beginning with Algebra I or skipping it and *soon* having calculus so well learned that college credit for it could be obtained. They were also offered a smorgasbord of accelerative opportunities, such as skipping grades and graduating from college early. Somewhat less able entrants were given less drastic suggestions but were nevertheless encouraged to speed up their progress in mathematics and science. A dozen years of experience have shown that youths able and eager to move ahead can do so readily if they and their parents are resolute and persistent in their search for suitable ways.

Probably the best opportunities currently available are the academic, fast-paced summer programs offered by CTY and its counterparts at Duke and Northwestern universities. During these three- or six-week programs students can learn precalculus, calculus, high school biology, chemistry, and physics, writing skills at four levels, German, American history, computer science at three levels, Latin, and so on.

These classes are based on or adapted from the many fast-paced mathematics classes pioneered by SMPY between 1972 and 1979. In such classes, apt students were grouped homogeneously according to knowledge of mathematics. Details about these are contained in Fox (1974, 1976) and Stanley (1976b). Calculus can also be learned quickly by mathematically apt youths, as George and Denham (1976), George (1976), Stanley (1976b), Bartkovich and George (1980), Mezynski and

Stanley (1980), Bartkovich and Mezynski (1981), and Mezynski, Stanley, and McCoart (1983) document rather fully.

## WHY NOT CONDUCT A CONTROLLED EXPERIMENT?

Because experimentation is a strong force in psychology and in my own background (e.g., Campbell and Stanley, 1966; Stanley, 1973), we were tempted to set up SMPY as a rigorously controlled experiment. On reflection, however, the initial SMPY staff came to believe that there were cogent reasons for not doing so. Some of those considerations were the following:

1. We were rather sure that the smorgasbord of accelerative educational opportunities we planned to offer the "experimental" subjects in the study was much more likely to help than to harm them. Therefore, it would be inadvisable to withhold such opportunities from a portion of the subjects (probably half of them) who in a controlled experiment would be assigned randomly to a "control" group.
2. There were not likely to be enough extremely high scorers to make the numbers in both the experimental and the control group sufficiently large to yield statistically powerful or precise comparisons between groups and subgroups. It seemed more sensible to take the ablest subjects and mass the experimental efforts on them.
3. The procedures, principles, and techniques that SMPY planned to develop would be disseminated widely by the press and in speeches, letters, articles, books, and newsletters, so withholding knowledge of opportunities from a control group of subjects would be impossible. The control group would be exposed substantially to influences designed only for the experimental group and that type of contamination would greatly weaken or even nullify the experiment.
4. By not having a control group from which certain presumably beneficial opportunities and information were withheld, it is possible to keep the study completely on an aboveboard basis, with no need to deceive anyone about anything. This openness is important in gaining the confidence of the students, their parents and teachers, and the general public.
5. Certain comparisons could be made by matching and other quasi-experimental procedures. Fox (1976) did this in her study of sex differences in mathematical aptitude and achievement, as have other SMPY researchers in trying to determine how well a certain special procedure worked (e.g., Benbow, Perkins, and Stanley, 1983; Pollins, 1983).
6. A great deal of SMPY's analysis of the results of its programs depends heavily on case-study clinical methods, using all known information about each individual with as much insight as can be mustered on the basis of considerable experience with many mathematically precocious youths (see Hudson, 1975). Burt (1975, p. 138) stated this point especially clearly:

With human beings, when the problem is primarily psychological, statistical studies of populations should always be supplemented by case studies of individuals; early histories will often shed further light on the origin and development of this or that peculiarity. Tests should be supplemented by what Binet called the *methode clinique*, and interpreted by introspective observations, designed to verify the tacit assumption that they really do test what they are intended to assess. After all, each child is a complex and conscious organism, not a mere unit in a statistical sample.

Fortunately, many of SMPY's procedures yield results so different from the usual ones that the effects are obvious. For instance, it is almost preposterous to suggest that if SMPY had not found a local youth when he was an overage sixth-grader and helped him in many ways to move ahead educationally fast and well, he would, nevertheless, have been graduated from a major university at barely 17 years of age and become an assistant professor at 21. The youngest recipient of a bachelor's degree in 1971 at Johns Hopkins was 19 years, 10 months old (Eisenberg, 1977). Two years later, under SMPY's influence, the youngest was 17 years, 7 months old, and three months later he had completed a master's degree also. Now 17-year-old graduates are frequent (see Stanley & Benbow, 1983). Similar strong observations could be made about most of SMPY's programs, such as the effects of the fast-paced classes.

## FOUR SEQUENTIAL ASPECTS OF SMPY

The first book-length report about SMPY's initial work (Stanley, Keating, & Fox, 1974) was entitled *Mathematical Talent: Discovery, Description, and Development*. To emphasize those three *D's* and a fourth *D, dissemination* of our findings, we sometimes abbreviate that title as MT:D4. *Discovery* is the identification phase during which the talent is found. *Description* is the phase during which the most talented students are tested further, affectively and cognitively, and otherwise studied a great deal. This leads to the prime reason for SMPY, the *development* phase. During it, the youths who were found and studied are continually helped, facilitated, and encouraged. Each is offered a smorgasbord of special educational possibilities (see Stanley & Benbow, 1982) from which to choose whatever combination, including nothing, best suits the individual. Some splendid mathematical reasoners try almost everything at breakneck speed, whereas others do little special. SMPY offers as much educational and vocational counseling and guidance as its resources permit, both via memoranda and individually as requested.

Most studies of intellectually gifted children are heavy on description but light on educational facilitation. From the start, the SMPY staff was determined to intervene strongly on behalf of the able youths it found. Thus, discovery and description were seen as necessary steps leading to emphasis on accelerating educational development, particularly in mathematics and related subjects. SMPY promotes curricular flexibility or acceleration.

## WHY ACCELERATION RATHER THAN ENRICHMENT IS STRESSED

There were both logical and empirical reasons why we chose to emphasize educational acceleration rather than enrichment. Our rationale was that the pacing of educational programs must be responsive to the capacities and knowledge of individual children. As Robinson (1983) eloquently stated, this conclusion is based on three principles derived from developmental psychology. The first such principle is that learning is a sequential and developmental process (e.g., Hilgard & Bower, 1974). The second is that there are large differences in learning status among individuals at any given age. Although the acquisition of knowledge and the development of patterns follow stable sequences, children progress through them at varying rates (Bayley, 1955, 1970; George, Cohn, & Stanley, 1979; Keating, 1976; Keating & Stanley, 1972; Robinson & Robinson, 1976).

The final such principle is that effective teaching involves assessing the student's status in the learning process and posing problems slightly exceeding the level already mastered. Work that is too easy produces boredom; work that is too difficult cannot be understood. Hunt (1961) referred to this as "the problem of match, which is based on the premise that learning occurs only when there is an appropriate match between circumstances that a child encounters and the schemata that he/she has already assimilated into his/her repertoire" (p.268).

The implication of the three principles delineated by Robinson (1983) is that the pace of educational programs must be adapted to the capacities and knowledge of individual children. SMPY found adapting existing curricula and making them available to younger students rather than writing new curricula to be most productive in meeting this need.

We did consider enrichment, however. There seemed to be four main kinds of educational enrichment: busywork, irrelevant academic, cultural, and relevant academic. In our opinion, only the third (cultural) is well suited to mathematically highly precocious youths. It does not, however, meet their needs in mathematics or in the other academic subjects.

*Busywork* is a well-known but usually unfortunate way for some teachers to keep their brightest students occupied while the class goes on with its regular work. It often consists of having gifted children do a great deal more of the subject they have already mastered, but at the same level as the class they have surpassed.

One of our eighth-graders, with a Stanford-Binet IQ of at least 187, was asked by his algebra teacher to work every problem in the book, rather than just the alternate problems the rest of the class was assigned. Because he already knew Algebra I rather well and needed to work few problems, he resented this burdensome chore. The busywork proved to be a powerful motivator, however. After that year, he took all of his mathematics at the college level. First, though, while he was still 12 years old this precocious youth took the regular introductory course in computer science at Johns Hopkins and earned a final grade of A. During the following summer he took a course in college algebra and trigonometry at Johns Hopkins, earning a B. From then on, at a local college for two academic years and two more summers, he took college mathematics through calculus and linear algebra and two years of college chemistry, with all A's. At age 15 he entered Johns Hopkins as a full-time student with 30 percent of the sophomore year completed. Three years later he graduated with a major in electrical engineering and began graduate work in computer science at MIT on a National Science Foundation Graduate Fellowship. Thus, in a rather perverse sense, his teacher had done him a great favor. Without SMPY's discovering him, however, he would probably have been forced to sit a whole year in each of numerous high school mathematics courses far below his capabilities. Instead, by age 24 he had a Ph.D. degree in computer science from MIT.

*Irrelevant academic enrichment* consists of not providing the type of advanced stimulation the brilliant student needs, such as faster-paced mathematics for the mathematically precocious. Instead, all high-IQ youths are offered a special academic course, nonacademic work such as games (e.g., chess), or creativity training largely divorced from subject matter. Although this may be splendid for those whose major interest is tapped, it does not assuage the mental hunger of the mathematically oriented (see Stanley, 1954, 1958, 1959).

*Cultural enrichment* consists of providing certain cultural experiences that go beyond the usual school curriculum and therefore do not promote later boredom. Examples are music appreciation, performing arts, and foreign languages such as Russian, Chinese, and Classical Greek (see Mill, 1924; Packe, 1954; and Wiener, 1953). Early experiences with speaking modern foreign languages and learning about foreign cultures also fit this pattern. The latter may be a type of stimulation that parents and teachers of high-IQ youths could provide from the early years. These do not, however, meet the specialized academic needs of the intellectually talented.

The fourth and last type of enrichment is what we term *relevant academic*. It is likely to be both the best short-term method and one of the worst long-term ones. Suppose, for instance, that an excellent, forward-looking school system provides a splendid modern mathematics curriculum for the upper 10 percent of its students from kindergarten through the seventh grade, and then in the eighth grade these students begin a regular Algebra I course. How bored and frustrated they are almost sure to be! It is not educationally or psychologically sound to dump these highly enriched students into the mainstream. Yet that kind of situation often occurs. Only if the kindergarten through 12th-grade curriculum is considered can this failure of articulation be prevented. Even then, a superb 13-year mathematics program without strong provisions for college credit would merely defer the boredom and frustration until the college years.

Therefore, none of these types of enrichment was felt to be suitable for the mathematically talented student. None would provide such students an appropriate mathematics education at an appropriate pace and also prevent boredom in later years. The problem of "match" that Hunt had discussed would not be solved. For the preceding logical reasons we felt strongly that any kind of enrichment except perhaps the cultural sort will, without acceleration, tend to harm the brilliant student. Therefore, high-level, accelerative instruction was deemed the most suitable alternative.

Furthermore, there is excellent support for acceleration in the professional literature. Wiener (1953, 1956), Bardeen (Young, 1972), Watson (1968), Fefferman (Montour, 1976b), Wolf (Keating, 1976, see index; Montour, 1976a), and others have benefited greatly from it professionally. Norbert Wiener had his baccalaureate at 14 and his Ph.D. degree at 18. Charles Louis Fefferman had his baccalaureate at 17 and his doctorate at barely 20; by age 22 he was a full professor of mathematics at the University of Chicago. Five years later, he was the first winner of the National Science Foundation's $150,000 Waterman Award. Before age 30 he had won the prestigious Field Medal in mathematics and become a member of the National Academy of Sciences.

John Bardeen, twice a Nobel laureate in physics, completed high school at age 15. Merrill Kenneth Wolf, now a prominent neuroanatomist and talented pianist, was graduated from Yale University in 1945 shortly after becoming 14 years old. James Watson had his Ph.D. degree at age 23, and before he became 25 had done with Francis Crick the work that later earned them a Nobel Prize. These examples could go on and on. Counterexamples, such as the ill-fated William James Sidis (Montour, 1975, 1977), who was graduated from Harvard College at age 16 but failed badly thereafter, are rare.

Terman and Oden (1947, pp. 264–66) found that the typical member of Terman's gifted group was graduated from high school about a year early. They advocated a moderate amount of acceleration for gifted youths. Hollingworth (1942), who worked with even abler children than the average of Terman's group, recommended considerable acceleration for them.

The University of Chicago's extensive experience with early entrance and fast progress in college during the 1930s showed it was indeed a feasible approach for certain students. After this program was largely abandoned because of financial and other reasons, the Fund for the Advancement of Education (1953, 1957) set up studies at a number of colleges and universities to admit well-qualified students at the end of the 10th or 11th grade. These were judged to be markedly successful.

Hobson (1963) and Worcester (1956) showed that, when properly arranged, early entrance to public school was beneficial. It seems to us especially unfortunate that their work is not well-known to most educational administrators, because its scope, practicality, and clarity make the findings hard to ignore.

Perhaps the most comprehensive study of educational acceleration was the splendid monograph by Pressey (1949). Anyone who can read it carefully and still oppose such acceleration certainly has the courage of his or her preconvictions. Pressey, Hobson, Worcester, and others reveal that opposition to acceleration is founded largely on emotionalized prejudices rather than facts. (Also, see Friedenberg, 1966). We do not know of a single careful study of actual accelerants that has shown acceleration not to be beneficial, though armchair articles against it abound (see Daurio, 1979; Pollins, 1983; Robinson, 1983).

Furthermore, Lehman (1953), a psychologist, teamed up with a specialist in each of various fields to study the ages at which the greatest creative contributions were made by eminent scientists, scholars, and prodigies of other kinds. The typical age at which eminent mathematicians and physical scientists made their most highly rated achievements was lower than the average age at which the Ph.D. degree in those fields is awarded in the United States. Many brilliant young men and women are still students when according to logic and history they should be independent researchers.

As a cautionary note, however, the eagerness of the brilliant individual to move ahead rapidly is crucial. If the youth is reluctant to take a particular accelerative path, such as going into Algebra I early, taking a college course, or skipping a grade, probably he or she should not be urged to do so. Unfortunately, many boys and girls are not allowed by their teachers, guidance counselors, principals, or even sometimes their parents to make calm, rational decisions about such matters. They may get so much bad advice that they give up in confusion. Many are simply forbidden to use a particular method of acceleration.

In summary, the SMPY staff believes that offering each splendid mathematical reasoner a varied assortment of accelerative possibilities and letting him or her choose an optimum combination of these to suit the individual's current situation is far superior to so-called special academic enrichment.

## WHY EDUCATIONAL PLANNING IS DONE WITH THE CHILD DIRECTLY

From its inception SMPY has tried to communicate chiefly with youths themselves, rather than through their parents. Reports of results of the testing competition have gone to them, even including discussion of percentile ranks on national norms and the like. We have also written them letters in response to their queries or their parents'. It is our belief that contacts of the facilitating agency, such as SMPY, should be mainly through the youth, even though he or she may be only 9 or 10 years old. After all, a child that age whose Stanford-Binet IQ is 170 or more (and SMPY seldom deals with any that young unless they are that bright) has a mental age of at least 15 years.

Moreover, we want youths to take charge of their own academic planning early and to use their parents and us as means for implementing their own decisions. Some parents object to this approach, of course. If communication from the beginning is with the student, such friction is usually minimized.

## SELF-PACING AS INAPPROPRIATE NEO-ENRICHMENT VS. INDIVIDUALIZED GROUP PACING

When we propose accelerative opportunities for mathematically highly talented youths, the school is likely to counter by offering to let them proceed "at their own pace." In practice, this usually means still sitting in the too-slow class, such as first-year algebra, while working ahead in the book and perhaps into Algebra II. Common sense and observation tell us that this is not likely to work well for most students, no matter how able. Any student that autonomous and well motivated would probably have little use for school. Our model is definitely not self-pacing, whether in the crude way described above or by means of programmed instructional materials.

Programmed instructional materials are almost sure to contain too many steps, and too small ones, for mathematically extremely able students. Also, such materials do not usually lend themselves to group-paced stimulation. Most of our precocious youths do not perform well against an abstract standard, such as number of chapters or frames completed. Similarly, a track man or woman does not usually run well alone or a tennis player perform his or her best against a weak opponent. Most of our students who have tried self-pacing or correspondence-study courses move far less swiftly and well than they do in special fast-paced mathematics classes. Therefore, we consider the group-pacing feature essential for most persons (cf. Macken et al., 1976), but with full allowance for some students to forge ahead far faster than others. It is a group-mentor, rather than a group-instructional, approach.

The group-mentor approach produces astoundingly good results. Skeptics should read about some of SMPY's fast-mathematics classes: Wolfson I (Fox, 1974; Stanley, 1976b; Benbow et al., 1983); Wolfson II (George & Denham, 1976); the summers of 1978 and 1979 (Bartkovich & Mezynski, 1981); and calculus (Stanley, 1976b; Mezynski & Stanley, 1980; Mezynski et al., 1983).

## EFFECTS OF SMPY PROGRAM PARTICIPATION

In this chapter we have delineated only our success stories to illustrate the use of our educational options. That is because they are the most useful. Obviously, students in SMPY's programs have met varying success. Some students can race through a three-week precalculus class and finish the entire precalculus sequence, whereas a few have great difficulty completing even Algebra I. Ability and motivation are two factors influencing this (Fox, 1974; Favazza, 1983). Interest is another. A student interested in many different things or preoccupied with another activity is not going to have much time or mental energy to spend learning precalculus. Yet that person may still feel that he or she benefited from the class.

Therefore, it is difficult to determine what criteria describe failure and also when to decide if a student has failed. The following example illustrates the point well. One of the highest achieving students in SMPY's second fast-paced mathematics class entered Johns Hopkins at age 16. He got terribly involved with computers, however, and began neglecting his classwork. After earning poor grades and committing several fairly serious computer pranks, he dropped out. At that point he might have been considered an academic failure. Nevertheless, he became a successful computer consultant. Several years later he returned to Hopkins, finished his baccalaureate with honors, and soon won a truly major national award.

Actually, the numbers who do not succeed at a high level in our programs are small. This is partly because participation has been voluntary. No person was forced to enter college early or skip a grade. Thus, most students unlikely to succeed in our programs select themselves out.

Anecdotes are not scientific evidence, however. Therefore, SMPY systematically follows up students to study their development and evaluates SMPY's programs. Those in SMPY's first three talent searches have been studied approximately five years after initial contact. Their development was traced through high school (Benbow 1981, 1983; Benbow & Stanley, 1982b). Students who had scored at least 370 on SAT-V or 390 on SAT-M (the mean scores of a national random sample of high school females) were sent an eight-page printed questionnaire. Over 91 percent of 2,188 SMPY students participated by completing the survey. The general conclusion of the study was that SMPY students had fulfilled their potential in high school.

Relative to appropriate comparison groups, SMPY students were superior in both ability and achievement, expressed stronger interests in mathematics and the sciences, were accelerated more frequently in their education, and were more motivated educationally, as indicated by their desire for advanced degrees from difficult schools. Over 90 percent were attending college, and approximately 60 percent of those were planning to major in the sciences. The results suggested strong relationships between mathematical talent of students in grades seven or eight and subsequent course-taking, achievements, interest, and attitudes in high school. SMPY's identification procedure was effective in selecting students in the seventh grade who achieve at a superior level in high school, especially in science and mathematics (Benbow 1981, 1983).

In addition to studying the development of mathematically talented students, the longitudinal study provides useful data for evaluating lasting effects of SMPY's various methods in facilitating the education of its students. It was found, for example, that the successful participants in SMPY's first fast-paced precalculus classes achieved much more in high school and college than the equally able invitees who had not participated. They were also much more accelerated in their education than the nonparticipants. The former were satisfied with their acceleration, which they felt did not detract from their social and emotional development. Furthermore, there appeared to be no evidence to justify the fear that accelerating the rate of learning produces gaps in knowledge or poor retention (Benbow et al., 1983). Similar results were found for those students who graduated from *college* before age 19 (Stanley & Benbow, 1983; Benbow & Stanley, 1983a) and the less accelerated students in the follow-ups (Benbow, 1981, 1983). Most of the SMPY students felt that SMPY had helped them at least some, while not detracting from their social-emotional development (Benbow, 1981, 1983). This was true even for the students with whom the staff of SMPY had not had much contact.

## PREDICTIVE VALIDITY OF SAT-M

The above findings attest to the predictive validity of the SAT-M. In addition, SAT-M and SAT-V proved to have great value for predicting which students would be able to accelerate their mathematical education radically. Of course, motivational factors proved crucial within the high-scoring group. Without considerable ability of the SAT-M and SAT-V types, however, even highly motivated students could not race ahead successfully in mathematics and related areas. For example, in the fast-paced summer precalculus programs the amount of mathematics learned was best predicted by the SAT-M score (Fox, 1974; Favazza, 1983).

We have found that the SAT-M score scale is valid right up to the top reported score, 800, *if* the criteria themselves have enough "ceiling" for the group. For instance, in the usual eighth- or ninth-grade Algebra I class, variation in this ability would probably make little difference in apparent success of students at SAT-M levels 500, 600, 700, or 800, because all of these exceed the mathematical reasoning demands of the course. Paying attention and doing homework and tests carefully are probably better determiners of grades among these high scorers than are differences of the order of even 100 to 300 points. Put a 500 SAT-M scoring individual into a fast-paced, homogeneously grouped Algebra III class designed for students scoring at least 700 on SAT-M, however, and he or she is unlikely to be able to keep up. There are reports that a test of appropriate difficulty loses its validity at some point short of the top of its score scale. Most such reports are actually commentaries on the lack of ceiling of the criterion, rather than intrinsic dropping-off of validity of the predictor. This is especially true when both the predictor and the criterion variables are ability-test scores.

## BENEFITS TO STUDENTS

The benefits to SMPY's participants are numerous. Among them are the following:

1. Increased zest for learning and life, reduced boredom in school, and therefore a better attitude toward education and other activities.
2. Enhanced feelings of self-worth and accomplishment.
3. Reduction of egotism and arrogance. At first this may seem counterintuitive, but repeatedly we have observed that SMPY students who learn with their intellectual peers in rigorous settings, such as special fast-mathematics classes, tend to develop more realistic understanding of their ability. These youths learn that, compared with national norms on standardized tests, they are superb, but less spectacular relative to each other. In regular mathematics classes, the typical SMPY participant earns such good grades with so little effort

that the temptation to feel superior is strong. For example, the 190-IQ boy who by age 11 had done extremely well in two college computer science courses and on the Advanced Placement Program examination in college calculus seemed far less egotistical than he was before entering one of our special precalculus classes at age 10. In the SMPY courses, he had to work hard to maintain an average rank, whereas as an accelerated sixth-grader he was vastly overqualified for all his regular subjects.

4. Far better educational preparation than they otherwise would get, especially in mathematics, which is basic to many disciplines.

5. Better qualifications for the most selective colleges and improved chance of being admitted to them.

6. Getting into college, graduate school, and a profession earlier, thus having more time and energy for creative pursuits.

7. Increased opportunities to explore more specialties and hobbies.

8. More time to explore various careers before marriage.

9. Less cost. Most accelerative procedures save the student and/or the parents money. Even skipping the last year of junior high school and going into senior high school a year early eliminates a year that the student must be supported at home. Eight credits earned by means of an Advanced Placement Program examination in calculus were worth nearly $2,300 of tuition at Johns Hopkins in the fall of 1984, and such costs tend to rise almost every year. Graduating from college in three years rather than four saves about one-fourth of all costs and can lead to paid full-time employment a year earlier than otherwise.

10. Being an unusually well-prepared, advanced entrant to college often brings the student to the attention of professors, who help him or her get started on important research early. This, in turn, usually leads to better graduate school opportunities, including improved financial support there. For example, five of SMPY's six radically accelerated youths who were graduated from college in 1977 at ages 15 to 18 won National Science Foundation three-year graduate fellowships (Nevin, 1977; *Time*, 1977).

11. It seems likely that accelerants will have considerably greater success in life, both professionally and personally, than if held age-in-grade (Stanley & Benbow, 1983). That likelihood may, however, depend rather strongly on the accelerant's ability to acquire the necessary tacit knowledge (Wagner & Sternberg, in press).

## BENEFITS TO SOCIETY

Presumably, whatever helps a sizable group of talented individuals use their abilities better should also benefit the larger society. It is easy to see that a number of the points made above about benefits to SMPY participants themselves fall into this category. Below are listed a few other, somewhat related, gains that society itself can expect from the four *D's* of SMPY and similar programs.

1. Students superbly prepared to major in the mathematical sciences, physical sciences, quantitative social sciences, and other areas where mathematical talent and keen analytical ability are essential or helpful.

2. More years of professional contribution and effective adulthood.

3. More income and sales taxes paid over a longer period of time.

4. Happier, more effective citizens who should understand better how to educate their own children.

5. Reduced cost of education. The policies and activities that SMPY espouses save school systems and colleges money rather than increase educational expenditures. When a student who already knows first-year algebra is moved into Algebra II, room for another pupil is created in the Algebra I class. Also, the teacher is free to work more effectively with the class, because a potential distractor or irritant has been removed. When a student skips an entire school grade, the cost of educating him or her that year is saved. If several years of precalculus mathematics can be learned in one year, a great saving of time and resources ensues. Passing introductory college calculus by examination increases room in the class and enriches the next mathematics course by moving an able, well-motivated student directly into it. Students who go through selective colleges in three years rather than the usual four enable those schools to handle more students.

It would be naive to assume that special policies and provisions for mathematically highly talented youths do not require any extra efforts. Much of the identification, study, and implementation, however, can be done by regular personnel in the mathematics supervisor's office. Even if in a strict cost-accounting sense the mathematically precocious were to cost a little extra, it would be an almost negligible amount relative to the expenditures for other types of special education within most school systems.

An often overlooked factor reducing the cost of working with intellectually gifted youths is the tremendous output one often gets for small inputs. A few instructional minutes spent with a brilliant youth can produce amazing results. This contrasts sharply with the much greater amount of time that must be devoted to a slow learner in order to get even moderate gains. Similarly, counseling SMPY participants and their parents by memorandum, telephone, letter, or case conference does not usually require a great deal of time but often produces striking changes in their education.

The two sentences with which I ended the first chapter of the first volume of *Studies of Intellectual Precocity* seem appropriate here: "Expensive curricular adjustments are made, quite justifiably, for slow learners. It is past time that fast learners get the much less costly 'special education' they deserve" (Stanley, 1974, p. 19).[5]

## SCARCE RESOURCES AND ELITISM

But even after the above points, some readers may still feel that any special attention to highly precocious youths is an unwarranted and unnecessary diversion of scarce resources. Won't the talented boy or girl get along well with the regular resources of the school? Don't elective courses and the considerable array of honors-type subjects in senior high school (calculus being an example) take care of the needs of the gifted satisfactorily? Why provide more for those who already have so much? Isn't that elitism and, therefore, contrary to the American way of life? One could argue endlessly about the philosophical content of these questions. Empirically, however, the answer is clear: Many of the youths in the top few percent of their age-mates with respect to mathematical reasoning ability can learn mathematics and related subjects faster and better than the curricula of most schools permit. If held to the age–grade lock-step, a large percentage of them will develop poor work habits and lose interest in the area. Even those who do not would usually benefit from better opportunities. Thus, a laissez-faire policy for education of the mathematically talented is misguided. Perhaps "genius will out," but much of the superior talent with which SMPY deals is unlikely to do so if unaided.

## TALENT VERSUS GENIUS

Many persons seem hostile toward intellectually talented youths, perhaps a little less so toward those splendid in mathematics than toward the verbally precocious. This contrasts sharply with the American public's generally favorable attitudes toward prodigies in music and athletics. Friedenberg (1966) and Stanley (1974), among others, have discussed how deep-seated this prejudice is. Expressions such as the following abound in literature back to Shakespeare's time: "Early ripe, early rot"; "So wise so young, they say, do never live long"; "For precocity some great price is always demanded sooner or later in life"; and "Their productions . . . bear the marks of precocity and premature decay" (Stanley, 1974, pp. 1–2).

We noted earlier that one disguise for dislike of the intellectually talented is to argue that they need no special help; it is assumed that they will succeed well educationally without it. Another tactic we have noticed is the comparison of a highly able youth with Gauss, Euler, Fermat, Galois, Pascal, Newton, or (especially) Einstein, a sort of reductio ad absurdum denigration of the former's intellectual talent by asserting that it is not the rarest genius. Terman encountered a great deal of this. Some reviewers criticized him because in his one-state sample, identified in a short while, he did not discover anyone who later became a worthy successor to the greatest musicians, artists, and writers of all time. Some insight into problems of defining and predicting genius may be obtained from Albert (1975) and Bell (1937).

Obviously, in SMPY's and CTY's 11 annual talent searches thus far in the Northeast we do not expect to have located or helped produce Nobel laureates, much less successors to Gauss or Einstein. To find someone even of the caliber of Norbert Wiener (1953, 1956) is perhaps more than we can reasonably expect.

On the other hand, we believe that SMPY is helping a number of exceptionally able young men and women go far beyond what they would probably have done without our intervention. That is sufficient for us: effective enhancement of talent, rather than the creation of genius. We might have been able to help a lonely, awkward person such as Wiener use his great talents better at an earlier age, and probably Einstein would have scored quite high in a contest like ours had he deigned to enter it, but those two men are examples of persons who somehow achieved magnificently anyway. If one has already thrown a coin and it has landed with the "head" side up, what is the probability of *that* occurrence? This is a foolish question, of course, but no more simplistic than reasoning from the success of Einstein and Wiener that great intellectual talent will lead inevitably to success. Those country churchyards chronicled by the poet Thomas Gray long ago hold their share of "mute, inglorious" Wieners and Einsteins as well as of Miltons. We suspect that many classrooms also serve as tombs for mathematical talent.

## A STRONG BOND

SMPY's top participants differ considerably in most personal characteristics except age. Some are tall and others are short. Some are introverted, others are extroverted. Some are much better verbal reasoners than others (range, 280–760V before age 13). Some are males and others are females. In fact, they probably differ at least as much from each other as do youths their age who are only average mathematically. These students have one important thing in common, however: They entered a challenging mathematical aptitude search and scored extremely well on a difficult mathematical reasoning test designed to be used with above-average students three to five years older than they. This powerful commonality reminds us of the famous lines from Rudyard Kipling's "The Ballad of East and West":

> Oh, East is East, and West is West, and never the
>   twain shall meet,
> Till Earth and Sky stand presently at God's great
>   Judgment Seat;
> But there is neither East nor West, Border, nor
>   Breed, nor Birth,
> When two strong men stand face to face, though
>   they come from the ends of the earth!

Read Kipling's male-chauvinistic "two strong men" as "mathematically highly precocious youths" and you have a summing-up of the rationale for SMPY. We believe that mathematical talent transcends sex, circumstance, and nationality and mandates special educational treatment of mathematical prodigies with respect to their area(s) of great talent. We consider accelerative procedures crucial because—to paraphrase Robert Browning—a mathematically precocious youth's reach should exceed his or her grasp, or what's an educational system for? We at SMPY will continue helping to extend both the reach and the grasp of youths who reason extremely well mathematically.[6]

## NOTES

1. It is well for the reader to keep in mind the nature of these five volumes, the years in which they appeared, and the fact that their publisher (the Stanford University Press) has kept the whole series in print for more than half a century. References are as follows: Terman (1925), Cox (1926), Burks, Jensen, and Terman (1930), and Terman and Oden (1947, 1959). Work reported in those volumes has been extended by Oden (1968), Sears and Barbee (1977), R. Sears (1977), and Ohanian (1977).
2. For SAT's history and rationale, see Downey (1961).
3. Even more psychometrically precocious was the boy of Chinese background who at age 10 years, 1 month scored 600 on SAT-V and 680 on SAT-M, and a year later scored 710V and 750M. (For his further achievements, see Stanley and Benbow 1983.) SMPY's youngest college graduate thus far is Jay Luo, born April 4, 1970, who received his BS degree in mathematics with honors from Boise (Idaho) State University in May of 1982. In the fall of 1982 he enrolled as a graduate student in mathematics at Stanford University. In 1985, at age 15, Mr. Luo began his fourth year there.
4. In 1979, SMPY helped create at Johns Hopkins the Office of Talent Identification and Development (OTID), now called the Center for the Advancement of Academically Talented Youth (CTY), to run the talent searches and conduct special educational activities. CTY, directed by Dr. William G. Durden, has done so since 1980.
5. The other eight volumes of that SIP series are by Keating (1976), Stanley, George, and Solano (1977, 1978), George, Cohn, and Stanley (1979), Fox, Brody, and Tobin (1980), Bartkovich and George (1980), Fox and Durden (1982), and Benbow and Stanley (1983a).
6. For some complementary or contrasting points of view, see Feldhusen (1983), Feldman (1979), Gallagher (1979), Laycock (1979), Michael (1983), Renzulli (1977), Tannenbaum (1983), Torrance (1977), and Wallach (1978).

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# Educating Mathematically Precocious Youths: Twelve Policy Recommendations*

*Julian C. Stanley and Camilla Persson Benbow*

Mathematical reasoning ability is a scarce and probably dwindling national resource. The Study of Mathematically Precocious Youth (SMPY) estimates that only about 25,000 persons in each student age group reason mathematically well enough to become *outstanding* engineers, mathematicians, physical scientists, or quantitative social scientists. All the professions and vocations that need great quantitative ability must compete for this limited pool of talent.

Of course, one can make strenuous efforts to develop the mathematical reasoning ability of students who are not already excellent in this respect. Better initial teaching will probably help some, and maybe a great deal. It makes no sense, however, to allow youths who (for whatever reasons of environment and heredity) already have this valuable ability to languish in what are, for them, painfully slow-paced mathematics and science classes. Those who are both able and eager to forge ahead of their age group educationally deserve every reasonable opportunity to do so (Stanley, 1977, 1980a).

Consider youths who reason so well mathematically that, even before taking a course called "Algebra I," they score higher on a standardized algebra test than children who have taken the course for a full school year. About half of the 12-year-olds who score 500 or more on SAT-M would do that well. The percentage is small, but the number from a given age group is likely to be around 12,000.

Most students who have picked up a great deal of algebra knowledge while in general mathematics or "pre-algebra" have to serve the same 135–158 hours in a first-year algebra classroom as other students who are far less mathematically knowledgeable. Usually, a class is paced according to the needs of the average student, who at the outset knows little algebra and may have slight aptitude for learning it even when the material is presented slowly. The least mathematically able students in the class slow the pace even more. Picture youths who are highly apt mathematically and their dilemma at being incarcerated in this situation. Can they insist that the teacher move faster? Should they daydream? Become the class clown? Manicure homework in order to make perfect grades, even though they don't need the practice? "Bait" the teacher? Show off their knowledge? Skip the class? Ask to be allowed to attend class only for quizzes and examinations?

These children are not likely to escape this situation in ways that articulate with the rest of the curriculum, such as second-year algebra. Mathematically precocious students are seldom allowed to prove that

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they already know algebra well, and perhaps even better than the junior high school mathematics teacher, because school systems rarely use tests to discover aptitude. The child's entrance to first-year algebra may be a simple, 40-item group test that requires less than 45 minutes to administer and two or three minutes to score and norm. For what to us are obscure reasons, most educators believe that every child should have a year of algebra, no matter how unnecessary. Many teachers consider the time serving itself important.

In many areas of education such as music and sports we readily accept the principle of placement according to competence. The age-in-grade system is not preordained. Before World War II one frequently found a mixture of ages in the classroom, especially in the one-room schoolhouse. The age-in-grade system is a rather modern invention based on "socially promoting" the least able and holding back the ablest.

When pressed to explain why they defy the commonsense notion that students who already know a subject should not have to take it, many educators vaguely question the validity of the standardized test or say that, in ways not explained, being in the class will somehow be good for the student's social and emotional development. It is remarkable that some students, bored and frustrated in this way, nevertheless preserve an interest in mathematics through the long procession that continues with Algebra II and III, plane geometry, trigonometry, analytic geometry, and (for the small percentage who persevere) calculus; unfortunately, quite a few do not. Usually, each of these must be pursued for a full or half Carnegie unit, in all requiring about five and one-half school years—more than 700 class hours. Most mathematically talented students (upper 3 percent) require far less time than that to learn this basic material (Bartkovich & Mezynski, 1981).

How can the time in class be shortened for students scoring 500 or above on SAT-M? SMPY has developed what it calls a DT → PI model: diagnostic testing followed by prescribed instruction (Stanley, 1978b, 1979). The basic principle is to determine what the knowledgeable student does *not* know about a given subject and then help him or her to learn just that, without having to take an entire course or wade through a textbook containing material already known. In this way, aided by skilled mentors (guides, not lecturers) and suitable materials, the youth is likely to master Algebra I in 15 hours or less. The mathematically brilliant student is unlikely to need much more than that for Algebra II, either. So, if the student's actual aptitude for learning mathematics this way proves to be high and he or she is eager to move ahead rapidly and willing to do homework well, the four-and-one-half-year process from Algebra I through analytic geometry can be shortened drastically. For example, 12 of the 33 highly selected boys and girls in SMPY's summer-of-1978 fast-paced precalculus program mastered up through analytic geometry in about 35 hours of instruction time, meeting four and one-half hours per day, one day per week, for eight weeks. From a less carefully selected group of 96 students, in 1979, five did that well (Bartkovich & Mezynski, 1981). (Success rates in the intensive three-week residential classes during the summers of 1980 and 1981 were even higher.)

Thus, in less than 6 percent of the typical minimum time, these 17 students were well prepared to start calculus, usually a 12th-grade subject, as eighth graders. Most of them did and they succeeded well. Later, several earned credit for two semesters of *college* calculus, usually by scoring high on the difficult Level BC of the College Board's Advanced Placement Program mathematics examination. These achievements opened new vistas to the students in mathematics and related subjects such as physics and computer science. They also provided time for other courses in the student's high school curriculum. In most cases, mathematically talented students chose to accelerate their progress through the school grades in order to enter college with advanced standing. Some of these students entered college with advanced standing (e.g., as sophomores or, in at least two instances, juniors) because of AP examinations they had passed and/or college courses they had taken on a part-time basis while still in high school. This extends for them the time when the most creative achievements in one's professional field tend to be made (Lehman, 1953.)

Furthermore, participating in a fast-paced mathematics program appears to have multiple effects. Not only is the time devoted to mathematics greatly reduced, but also the time used to complete one's education. In the eight-year follow-up of the students in SMPY's first fast-paced mathematics class, we found that the very successful students had achieved academically higher in high school and college than the equally able students who could not participate (Benbow, Perkins, & Stanley, 1982). This ties in well with Zuckerman's (1977) theory of the accumulation of advantage.

SMPY considers the DT → PI approach central to the proper utilization of our "smorgasbord of special educationally accelerative opportunities," from which students may choose *ad libitum* (Benbow, 1979; Stanley, 1978a). It is especially helpful in preventing mathematically talented youths from wasting time in beginning algebra, because that subject is almost trivially easy for many of them.

## POLICY RECOMMENDATIONS

On the basis of SMPY's 13 years of work with talented students and their longitudinal follow-up, we offer the following educational policy recommendations:

(1) *Students who are capable of achieving at a high level and are good prospects for educational facilitation should be identified early nationwide.* The use of the College Board's Scholastic Aptitude Test (SAT) with seventh and eighth graders is one such method (Stanley, 1977–78). It has not only been shown to be useful initially, but has also been validated over a long-term basis (Benbow, 1981). Moreover, duplication of the SMPY model has been done at Duke University for 16 states. This major effort, led by Robert N. Sawyer, began in September 1980.

Sanford J. Cohn has begun a Southwestern and Western extension of the SMPY model from the Department of Special Education at the Arizona State University, Tempe.

A program that begins with extremely young preschoolers was conducted for a number of years in the Department of Psychology of the University of Washington, Seattle, by the late Professor Halbert B. Robinson. It is now being continued by his associates (Robinson, 1982). This program has radically accelerative aspects, surpassing even SMPY's emphasis on educational acceleration.

(2) *Students should be allowed to take mathematical courses appropriate to their ability and achievement levels, regardless of their age.* In many school systems, even the most mathematically talented students are not permitted to study algebra formally until the ninth grade. In others, students in college preparatory curricula find algebra available when they are eighth graders. It would be desirable to have the eighth-grade option all over the country. Large public and private junior high schools may need a section of Algebra I for unusually able seventh graders.

Being underage or in a lower grade than the one in which algebra (or any other type of course) is offered should not prohibit a student from beginning the subject. For example, in one of SMPY's special, single-school, fast-paced Algebra I classes where only able fourth through seventh graders were enrolled, the top student was a fifth grader. In just 37 hours he learned the subject better, as judged by the Cooperative Mathematics Test, than all but 1 in 67 *eighth* graders do after an entire school year of instruction (see Stanley, 1976, pp. 132–146).

Another way to improve the situation for students who reason extremely well mathematically is to let them take two courses (e.g., Algebra II and plane geometry) during the same school year.

(3) *Intellectually talented students should be able to substitute courses such as college algebra and calculus, taken as a part-time college student, for high school courses that are either unavailable or too elementary.* Moreover, all colleges and universities should be encouraged to permit such enrollment for credit. At present, many public and private schools do not have such a policy.

It is not rare for SMPY's ablest, most motivated protégés to complete mathematics through the third semester of college calculus, differential equations, and/or linear algebra while still in high school. One intrepid youth finished the entire undergraduate mathematics curriculum of The Johns Hopkins University's Evening College, through complex variable theory and Fourier analysis, by age 16. Solano and George (1976) presented the initial findings from encouraging students identified by SMPY to take college courses on a part-time basis before entering college full-time. During the first five years of SMPY's existence, "131 students took 277 college courses and earned an overall GPA of 3.59, where 4 = A and 3 = B. . . . Community colleges are a great deal easier for these students than either colleges or universities. These youths experience little social or emotional difficulty in the college classroom" (Solano & George, 1976, p. 274). SMPY's extensive experience since then does not alter the above conclusions.

(4) *Taking Advanced Placement Program (AP) examinations by highly able students should be encouraged in all possible ways.* Success on them usually provides inexpensive college credit, waiver of the college courses, and permission to enroll at the next level. Each May the Advanced Placement Program of the College Board administers these college-level tests in a variety of subjects. If a student earns a high score on one or more of these difficult examinations, many colleges will grant credit.

SMPY has found that AP-oriented, college-level classes meeting two to two and one-half hours per week on 30 Saturdays or Sundays during the school year can help youths who are also taking the high school subject to score considerably better on the AP examinations (see Benbow & Stanley, 1978; Mezynski, McCoart, & Stanley, 1982; Mezynski & Stanley, 1980).

(5) *Some academically talented students should enter college as full-time students while still younger than the typical age, with or without having earned a high school diploma.* Many of the country's colleges, even some of the finest, however, refuse to accept an applicant for full-time enrollment without a high school diploma, some denying admission to high school graduates who are too underage, and some being reluctant to grant it. A few others welcome them. Much valuable time and motivation are probably irrevocably lost because of these restrictive age-in-grade policies. The age discrimination regulations of the United States Government should apply to a number of these situations. Also, state departments of education could authorize high schools to award diplomas to youths who leave high school a year or more early, after they complete a year of appropriate college courses satisfactorily.

Besides facilitating those who enrolled one year early, at age 17 rather than 18, SMPY has helped many to accelerate their high school education by from one to seven years. The following are a few examples:

- A student entered Brooklyn College from the sixth grade in 1973 at age 11½, started a mathematics major with Calculus III, and graduated in 1977 summa cum laude at age 15 years, 3 months. Two years later he received a master's degree in mathematics from an Ivy League university and continued there working toward a Ph.D. degree in the same field.
- A student entered Johns Hopkins with sophomore status at age 12 and received, with high honors, a B.A. degree in physics at age 15; others entered at 13.
- A student entered an Ivy League university at 13.
- A student completed the first semester at a fine New England college at age 12 with all A's.
- A student who had earned 64 college credits part-time while still in high school came to Johns Hopkins at age 14 as a junior and received a B.A. degree in biology at age 16.

During recent years, half a dozen students graduated successfully from Johns Hopkins at age 17 (see Stanley & Benbow, 1981–82). Quite a few others finished there or elsewhere at 18, 19, or 20, some of them with master's degrees. Of the 632 entering students at Johns Hopkins in the fall of 1980, 72 were at least one year underage. These included a 13-year-old female sophomore.

Eisenberg and George (1978) studied the progress of 35 early entrants during their first four semesters of college and 24 early entrants during their first two semesters. They found that the early entrants performed as well as or better than their age-in-grade classmates. Acceleration did not detract from their social and emotional development.

(6) *The age restrictions on all the National Science Foundation (NSF) summer institutes should be lowered.* Until the summer of 1980, highly able youths had to wait until they had completed the 11th grade before becoming eligible for an NSF summer institute. This is almost surely counterproductive for them and the country. It seems foolish that Mark Kleiman was one of the eight representatives of the United States in the Mathematics World Olympiad for two years before he became a high school senior, and yet was technically ineligible for an NSF summer institute in mathematics for at least one of those years.

For the first time during the summer of 1980, however, a number of NSF summer institutes were designed specifically for students in junior high school. We at SMPY hail this as a major advance.[1]

(7) *NSF should require that at least half of the NSF summer institutes be highly accelerative.* At present there is a restriction that such institutes must not anticipate any of the subjects usually taught later in high school or college. This is counter to nearly everything that SMPY has learned from its studies of how to help mathematically able youth forge ahead faster and better than the usual lock-step, age-in-grade Carnegie-unit school curriculum permits (see Stanley, 1978a). NSF's total commitment to educational "enrichment" rather than acceleration is not consistent with the findings of Daurio (1979) or Robinson (1982) or with the research literature on enrichment and acceleration (see George, Cohn, & Stanley, 1979). As Robinson concluded, "the pace of educational programs must be adapted to the capacities and knowledge of individual children" (p. 1). Optimal rate of learning occurs when there is a match between the circumstances that a child encounters and the schemata that he or she has developed.

We hope that many of the summer institutes will be conducted at the college level to prepare a student better for taking College Board Advanced Placement Program examinations in biology, chemistry, mathematics (Level BC, calculus), and physics (Level C). Thereby, students would earn college credit for these courses. A student should have scored at the 75th percentile or better on the College Board achievement test in the subject to be studied before entering this type of class. Besides this minimum, other criteria such as substantial scores on the Verbal and/or Mathematical parts of the Scholastic Aptitude Test or the American College Testing Program battery might also be used.

The benefits of earning two semesters of college credit early would be important. The stimulation of the college-level summer program would probably also cause the student to proceed that fall at the next level of the course (e.g., a sophomore year biology course, organic chemistry, Calculus III, or sophomore year physics) or study other fields.

(8) *Students who complete both a bachelor's and a master's degree in eight semesters or less should be eligible for NSF fellowships.* Currently, they are not. By making some of the ablest students in the country ineligible, the NSF graduate fellowships program may be denying support to a number of the type of students it most desires to help become outstanding scientists. The NSF fellowship are for only three years. Most persons will need at least that long to complete a top-level Ph.D. degree program, even if they already have a master's degree.

(9) *Government agencies and private foundations should consider allocating more financial support for the descriptive and long-term follow-up aspects of longitudinal studies such as characterize SMPY's learning how its high-scoring talent search participants turn out in the year 2000.*[2] The need for "pure" research is great. Much funding emphasis is on clever new ideas of a game-like nature. Applied research is less glamorous, but for many purposes careful description and evaluation over a long period of time are essential. Such research can tell us more about how mathematical *reasoning* ability develops. To what extent is it founded on non-verbal reasoning ability such as that measured by the Raven Progressive Matrices? What heredity base, if any, does it have? How is it related to largely algorithmic mathematics, such as elementary calculus, versus "pure" mathematics, such as number theory, analysis, topology, and higher algebra? How important is general intelligence for using mathematical ability? These and a host of other questions cry out for research. It should not be done, however, in lieu of special educational attention to every child in the country who reasons especially well mathematically. The results of such research can become available only "in the long run." Meanwhile, we know plenty with which to help mathematically able youths right now.

(10) *Research should be conducted to discover why females tend to have less well developed mathematical reasoning ability than males and to discover possible remedies.* Eleven years of investigating by SMPY have revealed that among intellectually talented students large sex differences exist in mathematical reasoning ability (Benhow & Stanley, 1980, 1981). Moreover, this sex difference in ability seems to be related to sex differences in mathematics and science achievement in high school and at the beginning of college (Benbow & Stanley, 1982). If talented girls tend to reason less well mathematically, spatially, and mechanically, is it any wonder that few of them find physics and engineering thrilling? Before urging bright girls who say they prefer biology or chemistry to shift into physics or engineering, on the assumption that they have been frightened away from them by the culture, it would seem sensible to investigate their cognitive abilities further. Of course, other aptitudes should also be included.

A great deal of work on vocational role models for mathematically able girls is being done by Fox (e.g., Fox, Brody, & Tobin, 1980). She and her associates are also studying the genesis of mathematical aptitude and

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achievement in girls (Fox, Brody, & Tobin, 1982). This last policy recommendation leads naturally into some suggestions for future research.

## FUTURE RESEARCH

(11) *Teaching gifted children how to use study time effectively should be a priority.* Many intellectually brilliant youths fall short of their potential because they are not good workers, even when the subject matter is at the right level and pace for them. They balk at thinking deeply even about topics that interest them, and they are unwilling to do homework carefully and well, particularly after having had a "free ride" for a number of years in school because of their brilliance. Homework, however, is crucial for success in SMPY's fast-paced and advanced classes. The SMPY staff often finds that the parents of these students are not good managers and motivators. They allow their children to put off their homework until the last minute and then to do it poorly. Often, there are no systematic study plans and routines in the home. We need to study carefully the setting in which each student works so that plans can be devised to prevent failing from lack of focused effort (Stanley, 1980b).

(12) *Research should be pursued on the causes of the great hostility toward precocious intellectual achievement that is endemic in this country and on ways to counteract it* (George et al., 1977). Why is a child violinist, composer, chess player, cinema star, or athlete lauded, whereas the child who excels mathematically or writes splendid poetry is sometimes regarded as a "freak"? This attitude may be stronger in the United States than in some other countries such as the Soviet Union and China. Whether or not it is, however, the deleterious influence on intellectual achievements is probably great. Furthermore, many people consider attempts to provide special educational opportunities for the intellectually talented as elitist. This, we believe, is based on a misconception: democracy does not mean that children must receive the same education, but instead that they should have equal opportunities to develop their abilities.

## CONCLUSIONS

With these 12 policy recommendations, some of which have several parts, we conclude the presentation of certain educational implications that have grown out of SMPY's decade of work with many thousands of boys and girls who, identified when most of them were 12-year-old seventh-graders, reasoned extremely well mathematically. Students such as these form the major basis for our country's scientific and technological future. We can and must help them use their abilities far better than is permitted at present. Otherwise, the United States is likely to fall far behind the Soviet Union and several other countries in scientific research and technological development.

Moreover, as *Science and Engineering Education for the 1980's and Beyond* (National Science Foundation and Department of Education, 1980) emphasizes, the United States has reached a critical period with respect to its continuing supply of high-level, innovative scientists and engineers. Especially needed are persons who reason extremely well mathematically and promptly earn doctorates from top-flight universities in crucial fields such as petroleum engineering, computer science, chemical engineering, electrical engineering, mechanical engineering, operations research, systems analysis, and mathematical statistics. But if recent test-score declines are an indication, the nation's limited supply of people possessing developed high-order mathematical reasoning ability is shrinking. Furthermore, most persons who reason exceptionally well mathematically at age 12, for example, do not use that invaluable ability well. These policy recommendations can help to ensure that academically talented youths receive recognition, systematic preparation, and opportunities to become superbly educated and trained.

"But," one could ask, "what's the hurry?" We have studied that issue in depth (George, Cohn, & Stanley, 1979). One part of the answer is that boredom kills interest, appreciation for the subjects, and sharpness of thinking. Wouldn't interest be stimulated when, in place of the mandatory time spent in beginning algebra in the eighth or (usually) the ninth grade, one needed only 0–25 hours with a good mentor working with a group of three to five math-able students? Even more dramatically, the staff of SMPY has often seen a student go from no credit even for first-year algebra to mastery of the entire precalculus sequence through college algebra, geometry, trigonometry, and analytic geometry (about four and one-half years of school mathematics) in 40–48 hours, or in a three-week residential program in the summer, or (when we were learning how to do this) in 100–120 hours of fast-paced instruction (see Bartkovich & George, 1980; Bartkovich & Mezynski, 1981). Not all highly able students complete the full sequence in such a short time, but the typical one masters about two years of school mathematics in five hours per day, one day per week, for eight weeks, or in the three-week residential program, with far more zest than in a usual class.

These eager, accelerated youths will go further educationally, in more difficult fields and at the most demanding universities, than if they were left at age-in-grade (see Benbow, Perkins, & Stanley, 1982; Nevin, 1977; *Time*, 1977). They will tend to stay more directly in the mathematical, engineering, and physical sciences and get outstanding doctorates, master's degrees, or baccalaureates before entering the job market at an early age. This enables them to be fully functioning professionals during their peak mental and physical years (see Lehman, 1953), when most of their equally able agemates are still students. Instead of receiving a doctorate at age 30, they will earn it by their early 20's or even the late teens. Both creative contributions and those of the "normal scientist" (Kuhn, 1970) are likely to be enhanced greatly by the better base laid earlier and the in-depth pursuit of important special fields. Furthermore, Zuckerman (1977) showed that the effects of being given special education are multiplicative. She describes it as the accumulation of advantage. In addition, this kind of educational acceleration saves the student time and frustration. It also saves the parents and the schools considerable money, because fewer years of education are required. For example, getting Advanced Placement examination credit for biology, calculus, chemistry, and physics usually earns the student sophomore standing and the chance to save one-fourth of the cost of his or her undergraduate education. Most of all, though, it produces earlier a far better, more fully prepared and presumably happier professional than would probably have resulted otherwise.

## NOTES

1. This recommendation and Numbers 7 and 8 might become moot, so far as NSF is concerned, if its entire science education budget is eliminated. Branscomb (1981) implied that this would not occur: "the National Science Board [which helps set policies and priorities for NSF] . . . will develop appropriate programs for precollege science education" (p. 516). Anyway, these recommendations are applicable to whatever agency or agencies may fund summer institutes for high school students. In this time of decreasing quality of science and mathematics instruction in junior and senior high school, such institutes are sorely needed.
2. We deeply appreciate The Spencer Foundation of Chicago's generous support of SMPY's activities ever since the study began in 1971.

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# Extremely Young College Graduates: Evidence of Their Success*

*Julian C. Stanley and Camilla P. Benbow*

Placement according to the individual's level of competence is a principle widely accepted in many domains, such as music or athletics. With regard to academic endeavors, however, there exist strong prejudices against educational acceleration even though a solid research base supports the practice (e.g., Stanley, 1974; Solano and George, 1976; Eisenberg and George, 1979; George, Cohn, and Stanley, 1979; Mercurio, 1980; Benbow and Stanley, 1984). Showing that educational acceleration does usually result in highly effective individuals could perhaps ease fears about the use of acceleration and open college doors to young and able students. Studying the later success of young graduates from college would provide important data.

Some scattered and fragmentary studies have already been conducted to discover what success such prodigies face later in life. These do *not* confirm the popular stereotype of "early ripe, early rot" (*Life*, 1945; Keating, 1976, *re* Wolf, p. 346; Montour, 1976a–d, 1977, 1978, 1979; Feinstein, 1977; Levy, 1978; Mardell, 1980; Stanley 1977–78; Stanley and Benbow, 1981–82, 1982). Yet, apparently, no complete list of an institution's youngest graduates has existed. Hence, no firm idea could be held as to the success after graduation experienced by all the early graduates of an institution. Studying a complete list of early graduates eliminates such bias as may arise from studying students in a special program or from a special time period. If most of the early graduates of an institution have led or are leading highly effective lives, this would constitute evidence for the value of acceleration and the importance of allowing eager young students to enter college early.

## METHODS

### *Subjects*

Any student not yet 19 years old receiving a bachelor's degree from the day school of The Johns Hopkins University from its founding in 1876 through the May 1982 commencement exercises[1] was considered an early graduate. In states that permit children to begin kindergarten in September if they will become five years old as late as December 31 of the same year, this means at least three or four years of educational acceleration.

Even though Johns Hopkins seems never to have required a student to have earned a baccalaureate in order to do graduate work, in this

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survey only the young recipients of the initial degree (currently, the Bachelor of Arts or the Bachelor of Engineering Science) were considered.[2]

### *Procedure*

For three years, names of early graduates were sought. Leads were solicited from all relevant administrators, present and former, including especially the registrar *emerita* and former deans. Also, every living retired faculty member was asked to search his or her memory. A letter appeared in the alumni magazine; it brought several responses. As the list was built up, several highly persistent false leads were pursued. Solicitations stopped when finally they produced no new information.

### *Results*

During the slightly more than 100 years of Hopkins' existence there were 32 early graduates, a 16-year-old in 1887 to three 18-year-olds and one 16-year-old in 1982. These completed their bachelor's degrees at an age in the range from 15 years 7 months to barely short of the 19th birthday (see Table I).

Twelve persons were under 18, meaning that they had been graduated from college no older than the typical high-school graduate. In the usual progression, the youngest would have completed only the 10th grade. Even there he, having been born in November, would have been rather young in age.

It is clear from Table I that the early graduates experienced success at Hopkins. Of the 31 for whom honors records were available, 20 (65 percent) graduated with honors, 11 with membership in Phi Beta Kappa, and 4 with NSF graduate scholarships (most of the 31 were not technically eligible for this award). One young lady became a Rhodes scholar and one young man a Churchill scholar. Inspection of Table I will also show that the early graduates earned membership in various other honor societies and won other fellowships. Clearly, success at the undergraduate level by these early graduates was quite remarkable.

But how successful are these "radical accelerants" likely to become, professionally and personally? Clues can be gleaned from the known records of the 12 oldest of the 32 persons listed in Table I. For example, Haskins, fourth in the table, Ph.D. degree at age 19, had a distinguished career as both a medieval historian and the dean of the Graduate School of Arts and Sciences at Harvard. Number six, Sternberg, became a professor of mathematics at Harvard by age 30. He is the author of a widely known book on celestial mechanics and also a noted Torah scholar. Eagle is a prominent biologist, widely known for developing the Eagle medium. Dryden was an eminent physicist. Kurrelmeyer had a long career as a professor of physics. Schaffer, who completed his M.D. degree at age 21, was well known in pediatrics. Fax, Wasserman (M.D. at age 22, and still practicing at 83), Raffel, Thomsen, Zafren, and Birx (Ph.D. degree at age 23) have all done well. There are no hints of "early ripe, early rot." It is apparent that these early graduates have led or are still leading highly effective adult lives.

## YOUNG JHU GRADUATES OF LONG AGO VS. THE MORE RECENT ONES

It can hardly have escaped the reader's attention that most (20) of the persons listed in Table I received their baccalaureates from Johns Hopkins during the ten-year period 1973-1982 (four of them in 1982), whereas the preceding 96 years seem to have yielded only 12. There have been somewhat more graduates per year recently (e.g., 446 in 1971 and 555 in 1982).[3] Also, it is probably easier to miss a young graduate of long ago than a recent graduate. Nevertheless, it is clear that the talent-facilitating efforts of Johns Hopkins' Study of Mathematically Precocious Youth (SMPY), founded in September 1971, have been the main cause of the sudden, sharp increase. Only two of the 20 recent early graduates were not SMPY's protégés. Joseph Louis Bates, who started the current trend in 1973 by earning both a bachelor's and a master's degree at age 17, was Stanley's first highly precocious youth, more than two years before SMPY began.

It appears that all the 20 young radical accelerants, born 1955-65, are off to good starts toward professional life. Most have gone right on to graduate work at excellent universities. Several already have Ph.D. degrees and good academic appointments; others are on the verge of doing so. This is especially impressive because most of the group are from the Baltimore vicinity. They were "local boys" who took advantage of the accelerative options offered them by SMPY through its annual talent searches and subsequent counseling. As considerably under-age undergraduates, most could live at home.

Of the 32 persons in the table, only two (Lynn Marie Daggett from Massachusetts and Nina Teresa Morishige from Oklahoma) are female. Johns Hopkins became coeducational in the fall of 1969, and even today 68 percent of the freshman class is male. The percentage of female early graduates may rise, but it does seem that intellectually highly talented girls tend to be less eager to accelerate than such boys are (Fox, Benbow, and Perkins, 1984). That attitude, too, may change as such girls receive more encouragement.

## SUCCESS OF YOUNG GRADUATES OF OTHER SCHOOLS

The youngest graduate of Johns Hopkins was 15 years and 7 months old. Yet age 15$^{7}/_{12}$ is by no means the country's record. One of SMPY's other protégés, Eric Robert Jablow, born March 24, 1962, was graduated from Brooklyn College *summa cum laude* in mathematics in June 1977 at age 15$^{1}/_{4}$ (*Time*, 1977; Nevin, 1977).

According to a personal communication from Professor Nancy M. Robinson dated July 9, 1982, the University of Washington has had three extremely young graduates recently. Mathematics major Sam Ho, born July 4, 1968, was graduated in June 1982, nearly a month before his 14th birthday. Mathematics major Alan Lippman, born June 5, 1967, finished at age 15$^{1}/_{12}$. Classics major Eva Von Dassow, born August 15, 1965, had been graduated two months before her 16th birthday. For details about that institution's remarkable programs, see Robinson (1984).

One of the most publicized young college students during the years since World War II was Michael Grost (Grost, 1970). In the late 1960's he was graduated from Michigan State University at age 15, Phi Beta Kappa, having majored in mathematics. In his early 20's he earned a Ph.D. degree from the University of Michigan.

For 36 years the late, famed founder of cybernetics, Norbert Wiener, seemed to be the youngest known college graduate in this country. He received his Bachelor of Arts degree from Tufts College (now Tufts University) in the spring of 1909, having been born November 26, 1895 (Wiener, 1953). Many years later Merrill Kenneth Wolf, born August 28, 1931 (*Life*, 1945; Montour, 1976a), was graduated from Yale College shortly after his 14th birthday with a major in music under composer Paul Hindemith. In June 1982 Sam Ho, mentioned above, broke that record by about a month at the University of Washington. In May 1982, however, Jay Luo, born April 4, 1970, received his Bachelor of Science degree from Boise State University in Idaho with honors in mathematics at the incredibly early age of 12 years 42 days. Thus, as in the speed of running the mile, there seems no lower limit in sight.

The published literature about the later success of early college graduates from other institutions is also chiefly positive. Charles Louis Fefferman (Roark, 1978; Levy, 1978), born April 18, 1949, completed his baccalaureate in both mathematics and physics at the University of Maryland in 1966 at age 17 and his Ph.D. degree in mathematics from Princeton in 1969 at barely age 20. By age 22 he was a full professor of mathematics at the University of Chicago. Now in his early 30's, Dr. Fefferman is already one of the world's most eminent mathematicians.

The brilliant record of Norbert Wiener (Ph.D. degree from Harvard at age 18) is well documented (e.g., in *Who's Who in Science;* Wiener, 1953 and 1956; and Montour, 1977). His career stands in stark contrast to that of William James Sidis, one of the few young graduates from college who failed. For a perceptive contrast and analysis, see Montour (1977).

Also see Montour (1976c) concerning three early entrants to college in 1920 and Bartlett, Westheimer, and Büchi (1965), Feinstein (1977), and Montour (1979) concerning the famed organic chemist, Woodward, who took his doctorate at M.I.T. in 1937 at barely age 20 a year after receiving his B.S. degree. For evidence of this kind concerning Nobel laureates, see Zuckerman (1977).

## WHAT NEXT?

Further increases in the number of extremely young graduates are limited by unwillingness of most parents to send their children away to college below the standard high-school-graduation age of 17 or 18. Such young students are likely to remain local enough to commute to the campus daily, unless special provisions are made for them. Thus far, these have not been set up at Johns Hopkins, where full-time early entrants have not been treated differently from other students. So far as the writers know, at present only two colleges or universities (University of Washington and Simon's Rock College at Great Barrington, Mass.) are fully geared to take able students a year or two early or even more. For a number of years Shimer College of Mt. Carroll, Ill. did. Creative solutions to this problem, which is more domiciliary than academic, would be welcomed by such youths.

Yet another procedure that helps provide an appropriate education for gifted students is likely to increase the number of early graduates. SMPY's continual efforts to help intellectually highly able youths learn their preferred subjects, especially mathematics, far faster and better than is likely to occur in regular classes (see Stanley and Benbow, 1982) have gradually been incorporated since 1979 into the much-broadened educational facilitation efforts of Johns Hopkins' Center for the Advancement of Academically Talented Youth (CTY), formerly called the Office of Talent Identification and Development (OTID). These programs have been adopted at various places, especially Duke University and Arizona State University at Tempe. In 1980 CTY began a major innovation by providing three-week, intensive, academic, fast-paced, residential courses on college campuses each summer. These are astoundingly successful in precalculus mathematics, writing skills, Latin, German (six weeks), biology, and chemistry.[4] Youths who reason exceptionally well verbally and/or mathematically may take two consecutive courses per summer for as many as five summers, beginning at the end of the seventh or even the sixth grade. From this are also certain to come increases in early entrance to college across the country, usually with advanced standing.

## COMPARATIVE STATISTICS FROM OTHER INSTITUTIONS

Data from other colleges are needed. Apparently, this is a neglected institutional research area. With computerizing in the registrar's office, however, it should be straightforward to search the final list of graduates during a given year by birthdate to get a print-out of the radical accelerants to check further. Knowing four persons who graduated from Johns Hopkins in 1982 quite young, we asked our registrar to seek others. Unexpectedly but reassuringly, he confirmed our list but could not add to it.

In this paper we show that students who have used various combinations of entering college early and forging ahead fast in the curriculum have led or are leading highly effective lives. Parents and educators should have less fear when attempting to accelerate a child. College administrators would be well advised to open their doors to young, but extremely able, students. Colleges and universities that provide appropriate support systems for intellectually highly talented, well-motivated students eager to study full-time, often before earning a high-school diploma, are likely to mine a rich vein of talent in the years ahead.[5]

## NOTES

1. If the student had completed all requirements for the degree, as certified by the university registrar, a semester early or at the end of the summer, that

date was used in lieu of the commencement date. In such cases both dates are shown in the compilation, the actual one and the commencement date.

2. For example, on May 27, 1982 a male student born May 12, 1964 received a master's degree in mathematics but lacked 9 of the minimum 120 semester-hour credits needed for the B.A. degree in philosophy. He is highly precocious, of course, more so than most of those in the present compilation.
3. According to personal communications from Robert E. Cyphers, University Registrar of Johns Hopkins, 19,517 baccalaureates have been awarded by the day school from 1982 back to 1879, the first year anyone (three-year degree program then) was graduated. For the 104 years this averages 188 graduates per year. Only one in 610 of all these is known to have been radically accelerated. That might, however, be the record for the country, especially recently; in 1982, four of the 555 graduates qualified for Table 1, i.e., one in 139. The ratio was about the same in 1977, when Camerer, Dietz, Stark, and Kotschenreuther qualified.
4. For example, during three weeks in the summer of 1982, 25 students aged 11-15 who had never studied high school biology before learned enough to average 727 (95th percentile) on the College Board's biology examination. The range was from one 590 (61st percentile) to two 800's (above the 99th percentile). During the next three weeks, four of these and nine others took chemistry, averaging 740 (94th percentile), with a range from one 600 (59th percentile) to two 800's (above the 99th percentile). Only two of the 13 students scored below 700. The two boys and two girls who took both courses scored as follows: 790, 780; 740, 800; 790, 740; and 720, 700. Not bad for a total of six weeks' study "from scratch" at ages 14 (three) and 15 (one). The 740B-800C scorer, a 14-year-old boy from the State of Washington, is legally blind; he used no aids except his regular eyeglasses.

   During the summer of 1983, CTY offered high-school biology, chemistry, and physics to persons aged 11-15 who had scored high on the College Board's Scholastic Aptitude Test (SAT).
5. Of course, the present study was limited to young college graduates, so its conclusions must be restricted accordingly. Evidence from various sources such as Montour (1976/c, 1977), Terman and Oden (1947), and SMPY's experience suggests, however, that most intellectually brilliant youths who become full-time college students two or more years early graduate in four years or, often, less. Further studies of the progress of young entrants to college would importantly supplement the studies of young college graduates.

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## NINE ADVANTAGES OF ENTERING COLLEGE AT A YOUNGER-THAN-AVERAGE AGE

1. Intellectually highly able youths can usually get considerably more academic stimulation and breadth of subject matter at a good college than during the last year or two in high school. They may thereby avoid boredom while learning more.
2. Being forced to remain in school through the 12th grade can have detrimental social and emotional consequences for the highly able student who is eager to move ahead faster than the usual rate.
3. Some 11th-graders are nearly as old as some 12th-graders, even though both are within the prescribed age range for the grade. The difference in chronological age may be as little as *one* day!
4. By entering a more sophisticated educational environment, there is greater opportunity to meet and interact with expert professionals in one's areas of interest.
5. By saving one or more years of schooling the student gains flexibility in education and related aspects of life. There is more time for career planning and compensating for obstacles and distractions that may develop along the way.
6. One can enter a profession or vocation earlier and have several extra years of vigorous youth in which to work more effectively. This can be especially important for physicians, who require many years of training and supervised experience before they become full-time professionals. It is also important for researchers trained at the Ph.D.-degree level, because their best work may be done while they are quite young.
7. Entering college early saves all costs of one or more years of high school, which are considerably higher than most persons realize. By increasing the distance between the accelerated student and his or her next-oldest sibling, it may space the children in a family better in college.
8. Graduate and professional schools tend to be impressed favorably by persons who are graduated from a college, especially an outstanding one, at a younger-than-average age.
9. Moving ahead according to one's best abilities is usually exhilarating and highly motivating. It helps build realistic self-confidence.

# Biological Correlates of High Mathematical Reasoning Ability*

*Camilla Persson Benbow and Robert M. Benbow*

## INTRODUCTION

The Study of Mathematically Precocious Youth (SMPY) has gathered extensive data showing that large sex differences in mathematical reasoning ability which favor males exist before age 13. In this paper we evaluate some of the major "environmental" hypotheses that have been proposed to account for this difference. We will conclude that these "environmental" hypotheses need to be reformulated in order to account for the findings with our population of intellectually talented youths. While it is possible to adapt these exclusively environmental hypotheses to fit our data, we propose to take an alternative approach, which involves both environmental and biological causes for the observed sex difference.

It has long been obvious that certain sex differences, such as those in height, weight, and onset of puberty, are largely determined by endogenous factors. No doubt these differences are also accentuated by the environment. Nevertheless, few deny that biological factors strongly contribute to these obvious sex differences. We now wish to propose that a combination of exogenous and endogenous factors also determines the sex difference in mathematical reasoning ability. In support of this hypothesis we present some new findings on possible biological correlates of extremely high mathematical and verbal abilities.

We recognize that any hypothesis involving biological differences between males and females will prove to be unpopular and controversial (see Tomizuka and Tobias, 1981; Stage and Karplus, 1981; Chipman, 1981; Egelman et al., 1981; Moran, 1981; Luchins and Luchins, 1981; Kelly, 1981; Benbow and Stanley, 1981). The scientific method, however, does not always allow one to take the most socially or politically expedient approach. In our opinion the evidence supporting a possible role for biological factors is sufficiently strong to merit serious consideration. We want to emphasize, however, that we are only proposing an hypothesis, not a proven theory.

The data presented in this chapter were obtained at the Study of Mathematically Precocious Youth (SMPY) and the Center for the Advancement of Academically Talented Youth (CTY). SMPY was founded

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at Johns Hopkins University in 1971 by Julian C. Stanley with the express purpose of identifying and educationally facilitating intellectually advanced students. In 1979 at Johns Hopkins he also helped create CTY, which carries on the tradition of talent searches and academic programs for academically talented students. The programs created by Julian Stanley have received well-deserved international recognition. Without his foresight, creative ideas, and dedication, the findings presented in this chapter, many of which he contributed to, could not have been made.

## SEX DIFFERENCES IN MATHEMATICAL REASONING ABILITY BEFORE AGE 13

### *The SMPY talent searches*

It is well documented that there are large sex differences in mathematical ability and achievement favoring males (Bieri et al., 1958; Very, 1967; Garai and Scheinfeld, 1968; Glennon and Callahan, 1968; Suydam and Weaver, 1970; Backman, 1972; Wilson, 1972; Fennema, 1974; Keating, 1974; Maccoby and Jacklin, 1974; National Assessment of Educational Progress, 1975; Ernest, 1976; Fox, 1976; Fox et al., 1980). In the United States these differences have been found after puberty when the mathematics curriculum becomes more abstract. Sex differences favoring males, however, are not consistent across all mathematical abilities. Boys excel in tasks requiring mathematical reasoning ability, whereas girls excel in computation (Fennema, 1974). Moreover, no differences were seen in ability to apply knowledge that has already been learned.

Before 1980 the generally accepted explanation for these differences was the differential course-taking hypothesis of Fennema and Sherman (1977). They postulated that males developed more advanced reasoning abilities because males enrolled in more advanced mathematics courses, especially higher level courses, than females. This hypothesis has often been used to discount as sociological artifacts the sex differences found in mathematical ability (e.g., Wise et al., 1979).

In 1980 Benbow and Stanley presented data collected over an eight-year period by the Study of Mathematically Precocious Youth (SMPY), which could not be accounted for by the differential course-taking hypothesis. They showed that large sex differences in mathematical reasoning ability were observed in pre-adolescent students with essentially identical formal educational experiences.

These findings were based on data obtained from SMPY's mathematics talent searches conducted in 1972, 1973, 1974, 1976, 1978 and 1979, and involved 9927 intellectually gifted junior high-school students, who were between 12 and 14 years of age. Students attending schools in the Middle Atlantic Region of the United States were eligible to participate in an SMPY talent search if they scored in the upper 5 percent (1972), 2 percent (1973 and 1974), or 3 percent (1976, 1978 and 1979) in mathematical ability on the national norms of a standardized achievement test administered in the regular testing program of the students' schools. Thus, both male and female talent-search participants were selected by equal criteria for high mathematical ability before entering. Girls comprised 43 percent of the participants in these searches.

As part of the talent search, these students took the College Board Scholastic Aptitude Test's mathematics (SAT-M) and verbal (SAT-V) sections. These tests normally measure developed mathematical and verbal reasoning abilities, respectively, and are designed for above-average 12th-graders (Donlon and Angoff, 1971). Most of the students in our study, however, were in the middle of the seventh grade and were less than age 13. Few had received formal opportunities to develop their abilities in algebra and beyond (Benbow and Stanley, 1982a,b). Our rationale was that most of these young students were demonstrably unfamiliar with mathematics from algebra onward, yet were able to score highly. This could presumably occur only by the use of extraordinary mathematical reasoning ability. As an example of this, we have established that a majority of the students in the top 10 percent of our talent-search students (i.e., the top 0.3 percent of the general population in ability) did not even know Algebra I completely. Yet they scored far higher than most high-school students exposed to algebra and geometry. Thus, we conclude that the SAT-M must function far more at an analytical reasoning level for our SMPY testees than it does for high-school juniors and seniors who have already studied abstract mathematics for several years. We define this talent as mathematical reasoning ability.

The results from the six talent searches are shown in Table I. Most students scored high on both the SAT-M and SAT-V. There were no important sex differences in verbal test scores. This is consistent with the findings for high-school students, who also do not show sex differences favoring girls in this specific ability (ATP, 1981). In contrast, Maccoby and Jacklin (1974) concluded that there is a fairly well-established sex difference in verbal ability favoring girls. It is approximately 0.25 S.D. in magnitude.

A large sex difference in mathematical reasoning ability was, however, observed in every talent search. On the average, the boys scored about 0.5 S.D. better than the girls did. Moreover, there were indications that the greatest disparity between the boys and girls was in the upper ranges of mathematical reasoning ability. For example, in SAT-M scores of over 500 (average score of college-bound 12th-grade males) boys outnumbered girls more than 2 to 1 (1817 boys versus 675 girls in all 6 talent searches). It should be noted that the boys' SAT-M scores had a greater variance than the girls'. This obviously relates to finding many more high-scoring boys than girls. Why boys tend to be more variable than girls has been addressed by Eysenck and Kamin (1981).

These results were limited by the fact that only selected, mathematically able, highly motivated students were tested. Also, too few cases of extremely high-scoring students were obtained to conclude whether greater differences exist at the high end of the scoring scale of the SAT-M.

### *Sex differences in mathematical reasoning ability among the most gifted*

In 1980 two new talent-search programs were developed. The first was a

## TABLE I

### SAT PERFORMANCE BY SEX OF 12–14-YEAR-OLDS IN A TALENT SEARCH

| | | Number | | SAT-M scores* (mean (S.D.)) | | SAT-V scores (mean (S.D.)) | |
|---|---|---|---|---|---|---|---|
| Talent-search date | Grade | Boys | Girls | Boys | Girls | Boys | Girls |
| March 1972 | 7 | 90 | 77 | 460 (104) | 423 (75) | | |
| | 8 + | 133 | 96 | 528 (105) | 458 (88) | | |
| January 1973 | 7 | 135 | 88 | 495 ( 85) | 440 (66) | 385 ( 71) | 374 (74) |
| | 8 + | 286 | 158 | 551 ( 85) | 511 (63) | 431 ( 89) | 442 (83) |
| January 1974 | 7 | 372 | 222 | 473 ( 85) | 440 (68) | | |
| | 8 + | 556 | 369 | 540 ( 82) | 503 (72) | | |
| December 1976 | 7 | 495 | 356 | 455 ( 84) | 421 (64) | 370 ( 73) | 368 (70) |
| | 8** | 12 | 10 | 598 (126) | 482 (83) | 487 (129) | 390 (61) |
| January 1978 | 7 and 8** | 1549 | 1249 | 448 ( 87) | 413 (71) | 375 ( 80) | 372 (78) |
| January 1979 | 7 and 8** | 2046 | 1628 | 436 ( 87) | 404 (77) | 370 ( 76) | 370 (77) |
| January 1980, 1981, 1982 | 7 and 8** | 19832 | 19937 | 416 ( 87) | 386 (74) | 367 ( 77) | 365 (76) |

| | Ratios of high-scoring talent-search boys vs. girls | | |
|---|---|---|---|
| | SAT-M ≥ 500 | SAT-M ≥ 600 | SAT-M ≥ 700 |
| 1972–1979 | 2.0 : 1 | — | — |
| 1980–1982 | 2.1 : 1 | 4.1 : 1 | 12.9 : 1 |

*All sex differences on SAT-M were significant by a two-sided *t* test, mostly at the $P < 0.001$ level.

**The few 8th-graders in this sample had been accelerated by 1 year in their education.

modification of the original talent-search procedure. As previously, any seventh grader or student of typical seventh-grade age in a higher grade in the Middle Atlantic area of the United States could participate in the 1980, 1981, and 1982 annual talent searches, which were conducted by Johns Hopkins' Center for the Advancement of Academically Talented Youth (CTY). The major change was that not only mathematically able students but also students in the top 3 percent in verbal or in overall ability were allowed to participate. Thus, we had a more general sample of intellectually talented students. These searches also had equal representation by sex. Despite these modifications, the mean sex difference remained constant at 30 points favoring males among 19,883 boys and 19,937 girls (see Table I and Benbow and Stanley, 1983a). As previously, no important sex differences in mean SAT-V scores nor in the distribution of SAT-V scores were found.

It is not the mean difference in SAT-M scores, however, that should be emphasized. Rather, the ratios of high-scoring boys to girls are of major importance. The ratio of boys to girls scoring ≥ 500 SAT-M (493 was the SAT-M mean of 1982–83 college-bound 12th-grade males) was 2.1 to 1 (based on 5325 cases); at ≥ 600 SAT-M (80th percentile of 12th-grade males) the ratio was 4.1 to 1 for the 806 students scoring that highly (Benbow and Stanley, 1983a). These ratios were similar to those reported in Benbow and Stanley (1980), but are based on a much larger and more general data base.

Scoring 700 or more on the SAT-M before age 13 is a rare occurrence. We estimate that students who reach this criterion (the 95th percentile of college-bound 12th-grade males) before their 13th birthday comprise the top 1 in 10,000 of their age group. Because of the rarity of such students, a special nationwide talent search was created in November 1980 in order to locate and educationally facilitate such students (Stanley, 1983). As of August 1983, the number of boys identified was 258 and the number of girls, 20: a 12.9 to 1 ratio (Benbow and Stanley, 1983a). This high ratio of boys to girls was found even though the available evidence suggested that essentially equal numbers of boys and girls took the SAT.

In summary, the total number of students tested in the Johns Hopkins regional talent searches and reported so far is 49,747 (9927 in the initial study plus 39,820 in the later study). Preliminary reports from the 1983 CTY Talent Search based on some 15,000 cases yield essentially identical results. In the 10 Middle Atlantic regional talent searches from 1972 through 1983, therefore, we have tested about 65,000 students. In this large sample it is abundantly clear that *far* more boys than girls (chiefly 12-year-olds) scored high in SAT-M, even though girls were matched with boys by ability, age, grade, and talent-search entry.

### *Consequences of sex differences in mathematical reasoning*

In view of the large sex differences in mathematical reasoning ability observed before age 13, it seemed important to examine the consequences of this difference. Benbow and Stanley (1982a) have carried out a longitudinal study for a subset of the talent-search participants in their 1980 study. These were the students in the 1972, 1973, and 1974 talent searches who as seventh or eighth graders scored at least 370 on SAT-V

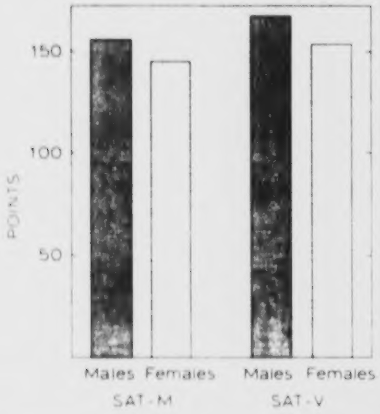

Fig. 1. Improvement on SAT-M and SAT-V during the junior and senior high-school years for SMPY's mathematically talented students by sex.

or 390 on SAT-M. These scores were equivalent to the average scores of a national sample of high-school females. Their development during the four or five years after participation in the talent search (usually during high school) was investigated. It was found that the sex difference in mathematical reasoning ability persisted and was related to subsequent sex differences in mathematics and science achievement (Benbow and Stanley, 1982a, 1983d). Both the verbal and mathematical reasoning abilities of males developed to a more advanced level than those of females during this time. Males improved their scores on SAT-M an average of 10 points more than females (the mean difference went from 40 to 50 points). On the SAT-V, however, the boys also improved their mean score by at least 10 points more than females (see Fig. 1). Moreover, sex differences in achievement during high school favoring males, which were related to and predicted by the initial sex difference on SAT-M, were found in participation in mathematics and science, performance on the SAT-M five years later, and performance on mathematics and science achievement and Advanced Placement Program examinations. The sex differences favoring males in science achievement test scores is shown in Fig. 2. The overall sex difference was slightly greater than 0.5 S.D. in biology and chemistry and approximately 1 S.D. in physics. Although the boys scored better than the girls on standardized tests of mathematics knowledge, it was of interest that SMPY females received better grades in their mathematics courses than SMPY males did (Benbow and Stanley, 1982a).

In summary, we have shown that sex differences in mathematical reasoning ability can be found at an early age (before puberty) among intellectually talented students. Moreover, these differences persist over a number of years and are related to subsequent differences in mathematics and science achievement.

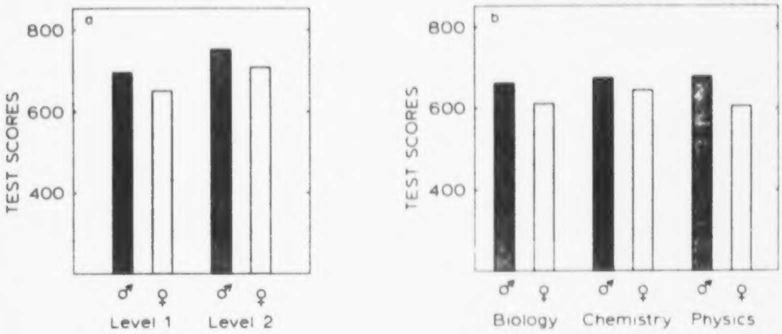

Fig. 2a

Fig. 2b

Fig. 2. (a) Sex differences on the College Board mathematics achievement tests taken at the end of high school by SMPY's mathematically talented students. (b) Sex differences on the College Board science achievement tests taken at the end of high school by SMPY's mathematically talented students.

## SOCIAL AND ENVIRONMENTAL HYPOTHESES

A large number of environmental and sociological hypotheses have been proposed to account for sex differences in mathematical reasoning ability in the general population. In this review, which is not meant to be exhaustive, we consider the major hypotheses, which, for convenience, we have grouped into four broad categories: differential course-taking hypothesis, masculine identification hypotheses, social reinforcement hypotheses, and the impact of socializers hypotheses. Each category will be evaluated to determine the extent to which it can account for the sex differences found in the SMPY population. We recognize that it is not possible to do full justice to the complexity of the environmental hypotheses in the limited space available, and apologize in advance for any oversimplification we may have introduced.

### *Differential course-taking hypothesis*

Fennema and Sherman (1977) postulated that sex differences in mathematical reasoning ability are observed in high school because boys take more high-school mathematics courses than girls. It is often called the differential course-taking hypothesis. Because SMPY boys did take slightly more mathematics in high school than SMPY girls, this might appear to be the reason why the boys improved more in their mathematical reasoning ability in high school. The boys, however, also improved more in their verbal reasoning ability, in spite of the fact that girls traditionally take more verbal courses in high school. More importantly, the differential course-taking hypothesis cannot explain why there is a large sex difference on SAT-M before high school. In addition, as we will show, differential course-taking does not even adequately account for the increase in the sex difference in high school. Firstly, the initial sex difference on SAT-M was found in the seventh grade *before* differential course-taking took effect, as is evident from the normal curriculum available to seventh graders and from the students' reports (Benbow and Stanley, 1982b). Secondly, an equal percentage of SMPY girls and boys took mathematics in high school straight up to the 12th grade, when the SATs are normally taken. SMPY boys did take about one semester more of mathematics than did SMPY girls. This difference, however, was due to the larger number of SMPY boys than girls taking calculus: calculus was completed after the SAT-M was taken and calculus items do not appear on the SAT-M. Finally, the best predictor of high school SAT-M score was talent search SAT-M, not the number of semesters of mathematics taken in high school, which accounted for little additional variance (Benbow, 1981). Clearly, the differential course-taking hypothesis does not explain either the ability difference found in this population or the increase in the ability difference during high school. The converse was, however, supported. The students who took calculus in high school had significantly higher initial mathematical and verbal reasoning abilities than students not selecting to take this course (Benbow and Stanley, 1982a).

### *The masculine identification and social reinforcement hypotheses*

The masculine identification hypothesis has been proposed to account for sex differences in mathematical achievement and perhaps also in aptitude (extensively reviewed in Fox et al., 1979). It is based on the postulate that it is necessary for one to identify psychologically with a male in order to have strong interest and ability in mathematics. We have not specifically tested this hypothesis for our population since Fox et al. (1979) in their review of the literature found contradictory results and thus rejected the masculine identification hypothesis.

Fox et al. (1979), however, presented "stronger" evidence to support the social reinforcement hypothesis. In essence, this hypothesis states that sex-related differences in mathematical achievement are, at least in part, the result of differential social conditioning and expectations for boys and girls. "The evidence shows that male prejudice against girls competing in mathematics does exist and the girls believe it exists. The perception of mathematics as a domain restricted to males may create a conflict for mathematically able girls between academic achievement and popularity, leading to reduced course-taking in mathematics" (Fox et al., 1979, p. 324). Furthermore, these investigators concluded that "differences in mathematics course-taking and ability seem to be less a function of biology and identification with a masculine role than of socialization forces (i.e., self-confidence with respect to mathematics, different career interests, and therefore, different perception of the usefulness of mathematics)" (Fox et al., 1979, pp. 324–325).

### *The socializer hypotheses*

Meece et al. (1982) also reviewed the literature describing how socialization might account for the observed sex differences in mathematics. Specifically, they addressed the impact of "socializers" (i.e., individuals who influence the socialization process of children). Their hypothesis states that the "attitudes of teachers, parents, and counselors often reflect cultural stereotypes regarding not only the alleged natural superiority of boys' mathematical abilities but also the different utility of mathematical skills for boys and girls . . . By embracing these views, socializers could undermine girls' confidence, their motivation to perform well, and their actual learning in mathematics" (p. 327). They postulate that there are three main processes by which this takes place: (1) because male and female adults exhibit different attitudes and behaviors toward mathematics, they create differences among minors through their influence as role models; (2) society has different expectations of boys and girls, which are indirectly and directly communicated; and (3) parents and other socializing agents encourage different activities and provide different toys for their children on the basis of sex, which may train different skills and interests. In their comprehensive review of the literature, Meece et al. (1982) found strong support for their hypothesis. The authors also found support for the related hypothesis that student attitudes toward mathematics and math anxiety (both variables favoring boys) were another source of sex differences.

Finally, in a related study of scientists, Benbow and Stanley (1983d) found in their literature review that the typical personality traits associated with scientists are more frequently held by males than females. Females and males in the same field, however, tend to be quite similar. There may be some differences in the way parents treat males and females, and parental evaluation may be more important to females than to males.

The studies on which these environmental and sociological hypotheses are based generally used students of average ability. Undoubtedly, these environmental and sociological factors are important in determining sex differences in mathematics in the average population. Do these hypotheses apply, however, to the students of superior intellectual ability whom we have studied?

## SOCIALIZATION HYPOTHESES AND SMPY

The validity of these hypotheses has been evaluated for the high-ability population studied by Benbow and Stanley (1980). No substantial differences were found in attitudes towards mathematics and the sciences (biology, chemistry, and physics) of these high-ability pre-adolescent boys and girls nor in their backgrounds (Benbow and Stanley, 1982b). Differences are predicted by the socialization hypotheses. Moreover, when these same students were studied five years later (after high school), few sex differences in attitudes were found. SMPY boys and girls reported liking mathematics, biology, chemistry, and science at that time. We found no substantial sex differences in their attitudes except perhaps towards physics (Benbow and Stanley, 1982a, 1983d). This was further exemplified by the fact that slightly more girls than boys were planning to major specifically in the mathematical sciences in college. In addition, SMPY females received better grades in their high school mathematics classes than did SMPY males. Moreover, reported attitudes toward mathematics had little relationship with subsequent achievement in mathematics. For example, attitudes toward mathematics at approximately ages 13 and 18 could predict neither the number of semesters of mathematics taken, SAT-M score in high school, nor the high school mathematics achievement test score (Benbow, 1981; Benbow and Stanley, 1982a).

Relevant in this connection is the finding of Benbow and Stanley (1982a) that high-aptitude girls may participate in mathematics less than high-aptitude boys, not because they like it less, but perhaps because they like verbal areas (especially English) to a greater extent than do boys.

SMPY students do not suffer from "math anxiety." A student with math anxiety would not enter a mathematics competition such as SMPY's. Additionally, the students with whom we deal are all in the top 3 percent of intellectual ability with a demonstrated aptitude for mathematics and above-average performance in their mathematics classes. Thus, the math anxiety hypothesis is not appropriate for this population.

Fox et al. (1982) have investigated the family backgrounds of SMPY talent search participants. They found few differences between male and female participants. In particular, few indications of differential training or encouragement of boys and girls were discovered. It is noteworthy that the study of Fox et al. was carried out by researchers who are not part of SMPY and who favor an environmental hypothesis.

It is of particular interest that the sex difference on SAT-M did not increase substantially during the five years of high school. The strong well-documented socialization pressures during junior and senior high school have remarkably little effect on sex differences in SAT-M scores. For socialization alone to account for our results, it becomes necessary to hypothesize ad hoc that mainly early socialization experiences significantly influence mathematical reasoning ability as measured by the SAT-M.

We urge caution when generalizing from the results of our limited study of highly able students. For example, it is possible that the variables measured were inadequate indicators of attitudes toward mathematics (i.e., mathematics liking, importance of mathematics for future job, and having rated mathematics as a favorite course in high school) since Fennema and Sherman (1976) have demonstrated that attitude toward mathematics involves several distinct components. Furthermore, the reason for not finding any substantial differences in the socializing experiences of our high-aptitude boys and girls may be because it was not possible to detect subtle social influences that affect a child from birth. Of course, our findings are limited to highly able students. Yet another important variable to be considered is the difference in toys that boys and girls play with. Our precocious boys may have more frequently played with toys that enhance their reasoning abilities than our girls did. Nevertheless, it is not entirely clear how differences in socialization experiences of boys and girls could affect the mathematical reasoning ability of girls so adversely and significantly, yet at the same time have no detectable effect on their reported attitudes toward mathematics, taking of mathematics courses during the pre-SAT years, and mathematics course grades. We are currently examining these hypotheses.

In summary, it appears that the main environmental hypotheses that have been proposed to account for sex differences in mathematical reasoning ability do not explain the results obtained for our high-aptitude group. Although large sex differences in mathematical reasoning ability before age 13 were found, few differences in the relevant socialization of the participants have been discovered. Thus, a reconceptualization of the commonly proposed environmental hypotheses is necessary in order to account for our data.

Rather than attempting to reformulate the environmental hypotheses, we propose to ask if other factors might also contribute to sex differences in mathematical reasoning ability. We do not dispute the fact that environmental influences contribute greatly to mathematical achievement and even to measures of mathematical reasoning ability. Instead, we wish to ask if endogenous factors may also contribute to the large sex difference we have observed.

### *Mathematical ability and spatial ability*

It has been proposed that spatial ability is related to mathematical aptitude (Smith, 1964; Sherman, 1967, 1977; Maccoby and Jacklin, 1974; Harris, 1978; McGee, 1979). Since there is a well-documented sex difference in spatial ability favoring males (see, for example, Maccoby and Jacklin, 1974, for a review), it has been proposed that sex differences in spatial ability can account for the sex difference in mathematical performance (i.e., Sherman, 1967). The results of testing this hypothesis are somewhat mixed, however. Armstrong (1981) did not find that sex differences in mathematics achievement were related to sex differences in spatial ability. Moreover, Becker (1978) found that the three-way interaction of spatial ability, sex, and item performance on the SAT-M was not significant for the seventh-graders in a SMPY mathematics talent search. Her conclusion was that among SMPY students there was no difference in performance from item to item on the SAT-M according to sex and spatial ability. Spatial ability was found, however, to be related to superior performance on the SAT-M as a whole. Becker's results could have been confounded by the spatial ability test used, which had a large verbal component. Thus, the girls may have solved the test using a verbal strategy (McCall, 1955; Sherman, 1974; Benbow, 1978). Alternatively, mathematically precocious girls may require higher spatial ability than mathematically precocious boys in order to perform as well on the SAT-M (Cohn, 1977).

Two studies by Fennema and Sherman (as cited in Sherman, 1977) have, however, found evidence that sex differences in mathematical ability could be attributed in part to sex differences in spatial ability. More recently, Burnett et al. (1979) found that the sex difference on SAT-M was no longer significant after controlling for spatial ability among a college sample. Finally, McGee (1979) concluded that "sex differences in various aspects of perceptual-cognitive functioning (e.g., mathematics and field independence) are a secondary consequence of differences with respect to spatial visualization and spatial orientation abilities" (p. 909).

In view of the results above, the possibility that mathematical reasoning ability and spatial ability are related deserves to be seriously considered. This may also be true for the SMPY population for an additional reason. In a separate study, the most precocious students that SMPY had identified using the SAT-M and SAT-V were tested with a battery of cognitive tests (Benbow et al., 1983b). Two factors accounted for their superior performance: a verbal and a spatial factor. Therefore, spatial ability may be influencing the test performance of mathematically precocious individuals. Moreover, sex differences in spatial ability favoring males were observed in this population (Benbow et al., 1983b).

There might not, however, be a direct link between the two factors (i.e., that spatial ability positively influences mathematical reasoning ability). Instead, these two mental abilities may simply involve similar cognitive processes. For example, both may rely on processes best performed by the right hemisphere of the brain. Thus, the close relationship may indicate that both abilities depend upon similar problem-solving strategies.

The possibility that there is either a connection or a parallel between mathematical reasoning ability and spatial ability is of great interest. A large amount of research has been performed on biological factors that may cause or influence spatial ability. We will review these in the following pages and attempt to relate them to mathematical reasoning ability.

## BIOLOGICAL HYPOTHESES FOR SEX DIFFERENCES

### *Sex-linked gene hypothesis*

O'Connor (1943) has proposed that spatial ability is controlled by a recessive sex-linked gene and that this may be the cause of the sex difference in spatial ability favoring males. He, and subsequently several other investigators (Stafford, 1961; Corah, 1965; Hartlage, 1970; Bock and Kolakowski, 1973; Yen, 1975), have reported a pattern of familial correlations that suggest the involvment of a recessive sex-linked gene. Vandenberg and Kuse (1979), however, performed a comprehensive literature review of the topic. They found several contradictory results and therefore did not support O'Connor's theory. They concluded that spatial ability showed a developmental trend, an influence from sex hormones, and might be an autosomal gene with reduced penetrance in women. That spatial ability is under some genetic influence has been clearly demonstrated by several studies (DeFries et al., 1978, 1979; McGee, 1979). This also seems to be the case for the SMPY population (Benbow et al., 1983c).

### *Laterality studies*

Another frequently proposed theory to explain the existence of sex-related differences in spatial ability is that men and women have the left and right hemispheres of the brain lateralized differently. Clinical and experimental data indicate that the left cerebral hemisphere is specialized for language processing and the right cerebral hemisphere is specialized for spatial processing (see Springer and Deutsch, 1981;

Bryden, 1982, for comprehensive reviews). Although the evidence that has been presented is not without some methodological problems, it does appear that males have greater right hemisphere specialization than females (see Bryden, 1979; McGee, 1979; McGlone, 1980; Springer and Deutsch, 1981, for reviews) as Levy (1972) proposed. Both Butler (1984) and Kimura and Harshman (1984) have investigated the possibility that males are more lateralized than females. This finding may account for some of the sex differences in spatial ability. Much further research, however, needs to be conducted before any firm conclusions can be drawn.

### *Hormonal hypotheses*

Many researchers have postulated that the different male and female hormones, androgens and estrogens respectively, produce sex-related differences in spatial ability. Petersen (1979) in her review of these studies found little support for the hypothesis that females excel on simple repetitive tasks and males at tasks that require perceptual restructuring because of sex hormones. There is, however, some support for the contention that high body androgenization is associated with low spatial scores among males and with high spatial scores among females (Broverman et al., 1964; Petersen, 1976). Thus, it may be the estrogen-androgen balance rather than the absolute level of androgen that affects spatial ability. This hypothesis states that the estrogen-androgen ratio is optimal and, as a result, spatial abilities are highest among males low in androgen and among females high in androgen (see Nyborg, 1984).

Sexual maturation is obviously dependent upon sex hormones. Waber (1977) found that late maturing children exhibit better spatial ability than children who mature early. She relates this finding to brain specialization: at the onset of puberty, there is a major reorganization of brain functioning (see Waber, 1979, for a review). Since girls enter puberty earlier than boys, their spatial abilities would tend to be less well developed at that point than in boys. Moreover, males who mature relatively early are perhaps more androgenous than males who mature later (Broverman et al., 1964). Thus, the influence of sex hormones on spatial ability may be through their effect on maturation, which in turn influences the degree to which a person becomes androgenized.

This is also consistent with the findings of Levy (1969), who found that spatial ability depended upon the degree of lateralization of the cerebral hemisphere of the brain. In 1976 she proposed that the degree of lateralization was determined by a gene which is under the influence of the sex hormones. Not entirely consistent with this hypothesis, however, is the fact that degree of lateralization may be established by birth or soon thereafter (Bryden, 1979, for a review). Petersen (1979) has also presented evidence that is difficult to reconcile with this position.

Also to be considered are the possible effects of hormones on the brain during early development. In their review, Reinisch et al. (1979) have concluded that: "(1) prenatal exposure to excess estrogen or to no hormone at all may have a negative influence on the development of spatial-perceptual skills but not on overall measures of intelligence, such as IQ: (2) progesterone exposure may enhance numerical ability; (3)

exposure to either exogenously introduced synthetic or naturally occurring progestins may augment school achievement; and (4) the absence of excess of sex chromosomes may have an effect on cognitive abilities and measures of general intelligence in some individuals." Moreover, Geschwind and Behan (1982) postulated that exposure to an increased level of testosterone in a developing fetus has as one effect the slowing down of neuronal development of the left hemisphere. As a result, the right hemisphere would become relatively more dominant. Such a connection would perhaps contribute to sex differences in spatial ability. Similarly, Levy and Gur (1980) proposed that high levels of fetal sex hormones (as are found in males) promote the expression of cerebral lateralization and selectively enhance the maturational rate and cognitive capacity of the right hemisphere.

### *Mathematical reasoning ability: biological correlates*

As mentioned above, mathematical reasoning ability appears to be related to spatial ability. Can the various biological explanations for the sex difference in spatial ability apply to mathematical reasoning ability? Little research of this type with mathematical reasoning ability has been done. Only one study has specifically dealt with the way biological factors affect mathematical reasoning ability. Stafford (1972) has shown that there is a genetic component to mathematical reasoning ability, and suggested that the pattern of familial correlations fit the sex-linked recessive gene model fairly well. Since this model was subsequently shown to be invalid for spatial ability, however, it obviously may not apply for mathematical reasoning ability either.

We have chosen to make the assumption, which seems reasonable although by no means proven, that the hypotheses that have been investigated for spatial ability also may apply to mathematical reasoning ability. We have begun to test some of these hypotheses for the abilities to reason mathematically and verbally among the intellectually precocious students identified by SMPY and the Center for the Advancement of Academically Talented Youths (CTY) at Johns Hopkins. Our findings suggest that there are certain specific physiological correlates of extremely high mathematical and verbal reasoning abilities.

## PHYSIOLOGICAL CORRELATES OF EXTREME ABILITY

When Julian Stanley and I first published our finding of sex differences in mathematical reasoning ability (Benbow and Stanley, 1980) much controversy was generated over the role of "nature" versus "nurture" in determining high intelligence. This had led us to search for other biological differences, in addition to sex, which correlate with extreme intellectual precocity. Presently, we have found three such correlates: left-handedness, immune disorders, and myopia. Some of our findings relate to possible biological origins for sex differences in cognitive abilities. We again wish to emphasize that this is only our working hypothesis, not a proven theory.

Two organizations at Johns Hopkins, SMPY and CTY, conduct annual national talent searches for pre-adolescents who are *extremely* precocious in their mathematical and verbal reasoning abilities, respectively. The criterion for extreme mathematical precocity is a score of at least 700 on SAT-M prior to age 13. Similarly, the criterion for extreme verbal precocity is a score of 630 or more on SAT-V prior to age 13. Both scores are equivalent to the 95th percentile of above-average 17–18-year-old males. We estimate that selected students comprise the top 1 in 10,000 of their age group. As of August 1983, we had identified 278 mathematically precocious students and 165 verbally precocious students. Our work on physiological correlates of extreme mathematical and verbal precocity is being performed on this sample. The work is still in progress (August 1983), so the frequencies reported here will be slightly different from those in the final report (see following article).

### *Handedness and intellectual precocity*

Each student was first asked to report his handedness to us and then later to complete the Edinburgh Handedness Inventory of Oldfield (1971). Students were also requested to report whether their natural parents and siblings considered themselves to be left- or right-handed. Ambidexterity was also assessed. Results from the inventory and from the self-report measure were in excellent agreement. Since our comparison studies dealt with self-report data, we will not present the data obtained from the inventory here.

Between 7 and 10 percent of the general population report that they are left-handed. Approximately twice as many mathematically and verbally precocious Caucasian students than Caucasian students in the general population considered themselves to be strongly left-handed ($P<0.01$). Many were ambidextrous. When we included such individuals, 19.3 percent of the mathematically precocious students were either left-handed or ambidextrous and 21.2 percent of the verbally precocious students (see Table II).

The degree of left-handedness and ambidexterity for the parents and siblings of these students is also shown in Table II. It is clear that the rate is lower among them than among the index cases but still higher than for the general population. Approximately 31 percent of the left-handed or right-handed students had a sibling or parent who was also left-handed. Thus, left-handedness appears to be a familial trait of these precocious students.

In a comparison study handedness responses were obtained from three independently selected samples. The first sample, which was least able, was comprised of seventh-grade students scoring least well in the 1983 Hopkins Regional Talent Search conducted by CTY. The combined SAT scores of this group were less than or equal to 540, which means that the students were scoring slightly above chance on the SAT. They must, nevertheless, still be considered gifted since only the top 3 percent in ability can participate in the Hopkins regional talent searches. Out of a sample of 465 students, 191 returned a questionnaire to us. We could see no logical reason for assuming that the non-respondents would differ from the respondents on the questions, such as handedness. Among such students, 9.5 percent were left-handed and 2.1

percent reported that they had equal facility with both hands (see Table II). The second sample consisted of students who had scored as a seventh or eighth grader at least 370 on SAT-V or 390 on SAT-M in 1972 or 1973. They were surveyed when they were approximately 23 years old. Among such students 10.7 percent reported that they were left-handed and 3.7 percent that they were ambidextrous (see Table II). The third sample of students was selected from the 1976 talent search and consisted of those seventh-grade students who met the following criterion: 2SAT-M + SAT-V ≥ 1330. The top one-third of the talent-search participants met this criterion. In this group, which was the most able of the three comparison samples, 15.7 percent were left-handed and 1.8 percent ambidextrous. Since the different ability groups demonstrated a progressively higher degree of left-handedness, it appears that this trait is more frequent among extremely intellectually able students.

### *Immune disorders and intellectual precocity*

The work of Geschwind at Harvard suggested that we should ask whether intellectually precocious students are more likely to suffer from immune disorders than individuals in the general population. Geschwind and Behan (1982) have shown that left-handers in the general population are more likely than right-handers to suffer from immune disorders, learning disabilities, and migraine headaches. Testosterone exposure in utero was proposed to explain this fact. Geschwind and Behan postulated that exposure to increased levels of testosterone as a developing fetus has two effects. "Testosterone slows neuronal development of the left hemisphere, while simultaneously affecting immune development, and thus favoring later immune disorders" (p. 5100). Retarding growth of the left hemisphere would make the right hemisphere relatively stronger and would increase the chance of becoming left-handed. We thus decided to investigate whether mathematically or verbally prococious individuals suffered from immune disorders.

Because there may be a difference between medical definitions of allergies and notions held by the general population, a rather sophisticated allergy and immune disorder questionnaire was mailed to both the students and their parents. This questionnaire was provided by Dr. Franklin Adkinson, who is a specialist in immune disorders at Johns Hopkins University. We found that approximately 56 and 54 percent of mathematically and verbally precocious students, respectively, suffered from symptomatic atopic disease (allergies of various kinds). By contrast, in the general population of the United States 10 percent suffer from this affliction (Stites et al., 1982). The percentage of parents and siblings having allergies was significantly lower ($P < 0.01$, see Table II). The severity ratings for the mathematically and verbally precocious, however, did not greatly differ from their parents' and siblings' (see Table II).

As a comparison, the allergy questionnaire was completed by 191 students in the first comparison group described above (i.e., the same age individuals scoring less than 540 on total SAT). Approximately 35 percent of those individuals reported having symptomatic atopic disease (see Table II). This is much less than for the extremely precocious

# TABLE II

## PHYSIOLOGICAL CHARACTERISTICS OF EXTREMELY PRECOCIOUS STUDENTS, THEIR FAMILIES, AND 3 COMPARISON GROUPS

| | 630 SAT-V students | 700 SAT-M students | 630 SAT-V and 700 SAT-M students | Fathers | Mothers | Brothers | Sisters | Low-scoring talent-search students (SAT < 540) | Students scoring < 370 SAT-V or < 390 SAT-M | Students scoring 2 SAT-M + SAT-V ≥ 1330 |
|---|---|---|---|---|---|---|---|---|---|---|
| Number | 115 | 218 | 34 | 364 | 364 | 223 | 212 | 191 | 271 | 162 |
| Percent left-handed | 15.4 (M = 24.0<br>F = 7.4)* | 15.1 | 13.8 | 9.9 | 9.5 | 13.8 | 11.5 | 9.5 (M = 10.8<br>F = 8.4) | 10.7 | 15.7 |
| Percent ambidextrous | 5.8 (M = 0<br>F = 11.1)* | 4.2 | 0 | 0.7 | 0.4 | 4.2 | 2.3 | 2.1 (M = 3.6<br>F = 0.9) | 3 | 1.8 |
| Percent having symptomatic atopic disease | 54.2 (M = 62.7<br>F = 46.4) | 56.5 | 53.8 | 34.3 | 36.8 | 47.1 | 32.1 | 35.1 (M = 38<br>F = 33) | — | — |
| Mean severity rating of symptomatic atopic disease** | 4.5 (M = 4.4<br>F = 4.5) | 4.4 | 4.2 | 4.6 | 4.7 | 4.6 | 4.8 | 4.9 (M = 4.8<br>F = 4.9) | — | — |
| Percent myopic | 75.5 (M = 71.4<br>F = 79.6) | 52.8 | 72.0 | 60.0 | 53.6 | 41.2 | 38.1 | 19.9 (M = 15.5<br>F = 23.4) | — | — |
| Mean age for onset of myopia | 8.4 (M = 9.3<br>F = 7.5) | 9.1 | 9.3 | 17.1 | 14.1 | 10.3 | 10.1 | 9.5 (M = 10.1<br>F = 9.2) | — | — |
| Percent entering puberty before 12.5 years | 31.6 (M = 18.5<br>F = 43.3)* | 18.4 | 14.3 | 14.8 | 42.4 | — | — | 31.6 (M = 20.2<br>F = 41.1)* | — | — |

*Sex difference between proportions was significant.

**3, infrequently recurring problem, no longer recurs; 4, mild recurring problem; 5, moderate recurring problem; 6, severe recurring problem.

students ($P < 0.01$), but the severity rating that they gave was slightly higher. It should be emphasized that this control group is also gifted, though less so than our most precocious group. Thus, our data suggest that symptomatic atopic disease may be a physiological correlate of extreme intellectual precocity.

### *Myopia, blood type and intellectual precocity*

Over the past 10 years we have noted that many of our most gifted students wore glasses. These observations, coupled with the work of Karlsson (1973, 1975), led us to investigate the possibility that extremely precocious students might tend to be myopic. We found that 53 percent of the mathematically precocious students were myopic and 75 percent of the verbally precocious students were myopic (see Table II), while less than 5 percent were farsighted. For the lowest-in-ability comparison group only 20 percent were myopic. In the general population approximately 15 percent of high-school students are myopic (Karlsson, 1975). Clearly, these are substantial differences. The mean age of onset of myopia was 9.1 for the mathematically precocious, 8.4 for the verbally precocious, and 9.5 for the lowest-in-ability comparison group (see Table II). The siblings of the extremely precocious were about 50 percent less likely to be myopic. Although this is a fascinating finding, we have as yet been unable to think of a plausible mechanism relating myopia to extreme intellectual precocity.

Although it has been reported that blood type related to social class in England (Beardmore and Karimi-Booshehri, 1983), we found no such relationship in our sample. Thus, blood type did *not* relate to intellectual precocity in our study.

## BIOLOGICAL CORRELATES OF MATHEMATICAL REASONING ABILITY

In this section we will attempt to relate our findings of biological correlates of extreme mathematical reasoning ability to the sex difference in this trait. The major biologically based hypotheses will be evaluated and we shall propose our own working hypothesis.

Sex differences in left-handedness and symptomatic atopic disease would be interesting. Unfortunately, because such a small number of females had scores that qualified them for the mathematically most precocious group, sex differences could not be investigated among that group. For the students qualifying for the verbally precocious group, there was essentially equal representation by sex. Among such students there were sex differences in the percentage of left-handers and in the percentage with symptomatic atopic disease (see Table II). These differences were significant ($P < 0.05$), however, only for the left-handedness data. For the comparison group, sex differences were also found, which were not large or significant.

How do these findings on immune disorders and left-handedness relate to brain dominance? Familial left-handers (i.e., those who have a close relative, such as a parent or uncle, who is left-handed) tend to be more bilateralized in their cognitive functions (McGee, 1979; Springer and Deutsch, 1981; Bryden, 1982). That is, the typical pattern of left-hemisphere dominance for language and right-hemisphere dominance for spatial tasks is not always found. Since our students, who have demonstrably superior skills in mathematical and verbal reasoning as well as in spatial ability (Benbow et al., 1983b), are more likely to be left-handed or come from families with left-handers, we *postulate* that bilateralization is related to their superior abilities. Similar findings have been reported by Burnett et al. (1982) for spatial ability for a college population. If this is the case, however, it is difficult to reconcile with the hypothesis that boys generally score better than girls on spatial tasks because males tend to exhibit greater specialization of their right and left hemispheres or are more lateralized (Levy, 1972). We are currently measuring brain dominance patterns of our verbally and mathematically precocious youths using a computer simulation of a tachistoscope for a verbal and a spatial task in order to resolve this issue.

Since most of our extremely intellectually precocious students did not appear to have entered puberty by the time they took the SAT at approximately age 12.5 (see Table II), our work may be relevant to the hormonal hypotheses proposed by Broverman et al. (1964) and Waber (1977). Because our students have developed superior intellectual abilities and sex differences prior to puberty, it is likely that other factors contribute to the sex differences in our data at age 12.5. We postulate that the onset of puberty may relate to the increase in the sex difference we observe during adolescence. Our data indicate that precocious boys do enter puberty significantly ($P < 0.01$) later than precocious girls (see Table II).

The point we wish to emphasize, however, is that the sex differences we observe were evident before the onset of obvious puberty. It is important to stress that our indicators of entering puberty were not refined, since we could not ask students in the SMPY and CTY programs overly sensitive questions or examine them medically. Our principal indicator for entering puberty was onset of menses for girls and the beginning of voice change for boys. Nevertheless, both the ages of our students and their responses indicate that most had either not entered puberty or had not been in it a very long time. In this context it is of interest that two studies have found sex differences in mathematical reasoning ability even among 7-year-olds and 9-year-olds (NAEP, 1975; Dougherty et al., 1980). Clearly, these youths have not entered puberty. Finally, the work of Petersen (1979) is difficult to reconcile with the hypothesis on the effect of timing of puberty.

Of the major biologically based hypotheses to account for differences in intellectual ability, only those dealing with early hormonal exposure are readily reconciled with our data. This does not imply that the other hypotheses are invalid. Each may still be correct for the populations studied, as was also true for the environmental hypotheses discussed earlier. A reformulation of these hypotheses is necessary, however, to account for the data gathered by SMPY and CTY.

We propose the following unifying hypothesis, which is consistent with our results, but needs much further work to validate. Our hypothesis is an extension of the hypothesis proposed by Geschwind and Behan (1982), in which exposure of the developing brain to testosterone is a major factor. It owes certain features to the biopsychosocial hypothesis of Petersen (1981). The environment and the interaction between environment *and* physiological structures are of key significance, however.

Geschwind and Behan (1982) proposed that exposure to increased levels of testosterone in the developing fetus retards neuronal development of the left hemisphere. This implies that the developing individual would have a (relatively) stronger right hemisphere. Because the left hemisphere, which is better at language processing, does not dominate over the right hemisphere, which is specialized for non-verbal problem-solving tasks (e.g., spatial problems), such an individual would have a greater chance at developing his/her spatial or mathematical reasoning abilities through environmental interactions. By contrast, an individual with a dominant left hemisphere would rely more on his left hemisphere and would attempt to solve problems using a verbal approach. Such initial biases are then accentuated by the environment, which shapes the development of cognitive abilities. In our hypothesis, sex differences occur because males are more likely than females to be exposed to increased levels of testosterone. Males are indeed more likely than females to be left-handed or to suffer from immune disorders, which would be consistent with this hypothesis. Moreover, the two consequences of fetal exposure to an increased level of testosterone, as predicted by Geschwind and Behan, were in fact found for mathematically precocious youths. This would be necessary in order to validate our model.

It is not yet clear how extreme verbal precocity fits into this picture. We are not certain what aspects of verbal reasoning ability are tested by the SAT-V, although the ability to form analogies is clearly one. Dimond and Beaumont (1974) used analogical as one adjective to describe the thought processes exhibited by the right hemisphere. Thus, it may be that verbal reasoning as measured by the SAT-V is dependent upon right hemisphere thought processes.

## SUMMARY

We conclude that large sex differences in mathematical reasoning ability are found prior to puberty among intellectually advanced students. This difference could predict subsequent sex differences in achievement in mathematics and science. Since few differences were found in the backgrounds and attitudes of the boys and girls tested, it is unlikely that simple environmental hypotheses can entirely explain our data. In addition, some of our findings on physiological correlates of extreme precocity are difficult to reconcile with most of the biologically oriented hypotheses that have been proposed to account for sex differences in cognitive functioning. We have proposed a single unifying hypothesis to account for sex differences observed by us.

Because there are well-documented differences in the environment as well as in the biology of boys and girls, we propose that it is a combination of *both* of these factors that causes the sex difference in mathematical reasoning ability.

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# Physiological Correlates of Extreme Intellectual Precocity

*Camilla Persson Benbow*

Among extremely mathematically and/or verbally precocious students (top 1 in 10,000 in such reasoning ability), the following three physiological characteristics were found at high frequencies: left-handedness, asthma and other allergies, and myopia. The first two of these *may* reflect the effects of a common influence on the nervous and immune systems during fetal development. Moreover, our results suggest that such highly able students have less marked specializations of their cerebral hemispheres for cognitive functioning. These results may bear on the etiology of intellectual talent and sex differences.

## INTRODUCTION

Throughout history left-handedness has, in the popular mind, been associated with many undesirable traits. For example, proportionally more left-handers than right-handers "have been said to be psychoneurotic, epileptic, stutterers, reading-disabled, mentally retarded, mirror-writers, poor in penmanship, deficient in spatial or artistic sense, stubborn, resistful of authority, inclined to lives of crime and moral dissolution, dirty, homosexual or bisexual" (23). Although these beliefs are certainly questionable, left-handedness has definitely been found to be associated with specific learning disabilities (20).

Moreover, immune disorders have been found at an elevated rate among left-handers and learning-disabled individuals (19, 20). Geschwind and Behan (19) proposed that a physiological mechanism affecting both brain structure and the immune system played a role in left-handedness and in learning disabilities. Specifically, they hypothesized that left-handedness and immune disorders are related to exposure in fetal life to high levels of testosterone or to high fetal sensitivity to testosterone. The testosterone slows the development of the left hemisphere and simultaneously affects the thymus gland and hence immune development. Because it has been shown in the fetal monkey that diminution of the size of one area in the cortex may lead to enlargement in the homologous region of the opposite side and in areas adjacent to the one whose development is impaired (21), Geschwind and Behan postulated that prenatal testosterone exposure may enhance right hemisphere development and perhaps functioning.

Spatial abilities, which may be important in mathematics, depend on parts of the right hemisphere and on the posterior association cortex in the left hemisphere (9, 29). Results for mathematics are similar (38). Thus, if Geschwind and Behan's hypothesis is correct, one would

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predict that left-handedness and immune disorders should also more frequently characterize mathematically talented individuals than unselected individuals. The results of three previous studies were consistent with this prediction. Heim and Watts (24) found a slight advantage favoring left-handers on a numerical reasoning test, and Annett and Kilshaw reported that left-handedness is found at a higher frequency among university mathematics teachers and students (1). Moreover, Burnett, Lane, and Dratt (12) found in a college population that non-right-handedness was associated with higher scores on a spatial ability measure.

The purpose of this present study was to study left-handedness and immune disorders among a group of young but extremely precocious mathematical reasoners and a group of extremely precocious, young verbal *reasoners*. If the findings were to be consistent with our prediction, they would provide evidence for a physiological correlate of high intellectual ability and could also conceivably relate to the large sex difference in mathematical reasoning ability found among intellectually talented students (5–8).

Furthermore, in the course of studying extremely precocious students, we noted that many wore glasses. Because of this observation and previous studies that had shown a relationship between myopia and high intelligence (2, 26, 28, 34), we also studied the incidence of myopia among the extremely talented students, even though the Geschwind-Behan hypothesis does not include myopia.

## METHOD

### *Subjects*

As of November 1983, 417 extremely precocious students had been identified out of over 100,000 gifted students who had been tested approximately five years earlier than usual with the College Board Scholastic Aptitude Test (SAT), Mathematics (SAT-M) and Verbal (SAT-V), in a talent search covering the entire United States. The selected students had scored at least 630 on SAT-V and/or at least 700 on SAT-M *before* age 13[1]; 292 met the mathematics criterion and 165 the verbal. Such students exhibit extreme intellectual precocity and are estimated to represent the top 1 in 10,000 of their age-group in mathematical and/or verbal reasoning ability. Relevant information was available for 96 percent of the students selected by these criteria. The mean scores of the students in this study were 677 on SAT-M and 560 on SAT-V, which did not differ significantly from the SAT scores of the 18 non-participants. Students meeting the verbal criterion tended also to have high mathematical reasoning ability (32). The reverse was not necessarily true.

In this study, individuals of Asian ancestry were over-represented (22 percent) among students qualifying for selection by scoring at least 700 on SAT-M. Because left-handedness is less accepted in those cultures (37), Asians were tabulated separately. It was not considered necessary to study the Asians separately on the other variables, as no statistically significant differences were seen.

## PROCEDURES

An initial screening by telephone indicated that these precocious youths were more likely to be left-handed or ambidextrous than the general population. Thus, the Edinburgh Handedness Inventory of Oldfield (33) was then mailed to the students and their parents. In addition to completing the inventory for themselves, parents were requested to report the handedness of their other children. Scores on the Oldfield, designated as laterality quotients (LQ), range from −100 (complete left-handedness) to +100 (complete right-handedness). In this study we adopted Oldfield's criterion of left-handedness, i.e., LQ < 0, which does not include ambidextrous individuals as left-handers. Geschwind and Behan (19) found that 7.2 percent of the general adult population in Glasgow were left-handed by this criterion, a figure similar to that found by Oldfield (33).

Because our intellectually precocious students were significantly more left-handed as indicated by the pilot study, we also investigated the frequency of immune disorders. Initially, individuals were asked if they or their parents had asthma, allergies, or any other immune disorder. Approximately 50 percent of the intellectually precocious students report having symptomatic atopic disease (allergies). Thus, a more sophisticated questionnaire[2] that classified symptomatic atopic disease not only by frequency but also by severity, duration, and type was also mailed to all the precocious students' parents. To ensure consistency, one parent was asked to report for the entire family of the precocious student. A reported allergy was tabulated if it had occurred on a *regular* basis at any time in the person's life (see Table 1 for the rating scale). This questionnaire also included questions on any possible visual problems of the family members and the age diagnosed, if present.

Because our two samples of intellectually talented students may not be comparable to the general populations tested in the Oldfield or Geschwind and Behan studies and other possible comparison groups cited in the literature, we also formed our own comparison group. Responses to the same questionnaire mailed to the extremely precocious students and their families were obtained from a sample of 257 students scoring least well on the SAT in the 1983 Johns Hopkins University's Regional Talent Search.[3] These individuals had, as seventh-graders, a *combined* score on SAT-M plus SAT-V of less than or equal to 540 (i.e., their scores were near or at chance). Students in the comparison group, however, should still be considered well above average in ability, since only approximately the top 5 percent on standardized achievement tests are permitted to participate in the talent searches (5, 8). At the time of completion of the questionnaire, the comparison group of students were approximately 13 years old. Slightly more females than males (53 percent vs. 47 percent) were represented in this group, but no sex differences were found on the variables studied. Interestingly, less than two percent of these low-scoring students were Asian-Americans.

## RESULTS

### *Left-Handedness*

The frequency of left-handedness for the extremely precocious youth was much higher (15.5 percent, or about twice[4]) than the 7.2 percent rate found by Oldfield and Geschwind and Behan. An interesting pattern emerged among the four groups of extremely talented individuals, however (Table 1). The highest frequency of left-handedness was among the $\geq$ 630 SAT-V (termed 630V) males, followed by $\geq$ 700 SAT-M (700M) females, 700M males, and 630V females. To test for statistically significant differences among the groups by a chi-square, the 700M males and females were combined because of the small number of such females in one of the cells. The difference among the three groups was almost statistically significant ($p < .1$), with the 630V males being more than twice as likely to be left-handed than the 630V females ($p < .05$).

Among Asian-Americans 4.9 percent were left-handed. This is higher than reported for Chinese but similar to a figure reported for Oriental-American school children (37). (Many of our students of Asian parentage were first-generation Americans.) Interestingly, the range of LQ's $\geq$ 0 for our sub-sample of Asian-Americans did not differ from other precocious students. This is evidence for a strong social pressure among the Asian-American families against writing and eating with the left hand.

Among the comparison group of low-scoring students, 9.7 percent were left-handed as determined by the Oldfield inventory, which was significantly lower ($p < .05$) than for the extremely precocious. Frequency of left-handedness among the comparison group was similar to that found among the siblings and parents of the extremely precocious (see Table 1). No substantial sex differences were found among the comparison group or its siblings. Fathers were, however, more frequently left-handed (11 percent) than mothers (7.5 percent). This difference was not statistically significant. Finally, patterns of left-handedness among parents did not differ by child's sex and talent group.

### *Symptomatic atopic disease*

Approximately 54 percent of the extremely intellectually precocious students were reported to have symptomatic atopic disease, with no statistically significant differences among the four groups (Table 1). Interestingly, the 630V females were again the least likely to exhibit this trait. Using this instrument, Adkinson (personal communication) found a frequency of symptomatic atopic disease of 20–25 percent for a population of average-ability individuals.

Symptomatic atopic disease was significantly ($p < .01$) more frequent for extremely precocious students (54 percent) than for their parents (43 percent), their siblings (35 percent), and the comparison group (35 percent). There were no statistically significant sex differences, except between the brothers (40 percent) and sisters (29 percent) ($p < .05$). Severity ratings were, however, slightly higher for the precocious group than for their family members ($p < .01$ for parents). Severity ratings and their distribution showed no other interesting pattern. Finally, left-handers were slightly, but not significantly, more likely to have allergies with higher severity ratings than right-handers. Thus, symptomatic atopic disease is a physiological trait exhibited in elevated frequency by extremely precocious children.

### *Myopia*

The possibility that extremely able students would be more myopic than less able ones was investigated through the questionnaire completed by the parents. It was found that the majority of these students (over 50 percent) were myopic (Table 1), while less than 5 percent were hypermetropic (10 percent had astigmatism). In the comparison group and in a general population of high school students (28), significantly less ($p < .01$) were myopic (20 and 15 percent, respectively), as were the siblings (36 percent) of our precocious students. Among the parents of the extremely precocious, 52 percent were myopic; however, the frequency of myopia increases with age. Again an interesting pattern emerged. The verbally precocious students and females were more likely to be myopic than males or mathematically precocious students ($p < .05$). This pattern for the four groups was not duplicated in the parent data. Yet among the siblings and the comparison group, there was a trend for females to be more frequently myopic than males.

The average age when myopia was diagnosed is shown in Table 1. For the intellectually precocious students this was approximately 8, significantly ($p < .01$) younger than for the comparison group, siblings, or parents. Published data indicate that less than one percent of individuals are myopic by 8 (17, 25).

## DISCUSSION

In this paper, we identified three physiological traits that occur frequently in youths of extreme mathematical and/or verbal precocity: left-handedness,[5] symptomatic atopic disease (asthma and other allergies), and myopia. We also found an over-representation of Asian-Americans among extremely mathematically talented students, but not in the high verbal or the comparison group. Although the latter is interesting, the finding is difficult to interpret.

Geschwind and Behan (19) had postulated that left-handedness and immune disorders are related to exposure in fetal life to high levels of testosterone or to high fetal sensitivity to testosterone. They suggested that testosterone slows the development of the left hemisphere and simultaneously affects immune development. Because diminution of the size of one area in the cortex may lead to enlargement in the homologous region of the opposite side (21), prenatal testosterone exposure was postulated to enhance right hemisphere development and perhaps functioning (19). Our results were consistent with this hypothesis,

## TABLE 1

### FREQUENCY OF PHYSIOLOGICAL TRAITS AMONG THE INTELLECTUALLY PRECOCIOUS,[1] THEIR FAMILIES, AND THE COMPARISON GROUP

| | Mathematically Precocious Youth | | Verbally Precocious Youth | | Parents | Siblings | Low-Scoring Comparison Group (SAT-M + SAT-V ≤ 540) |
|---|---|---|---|---|---|---|---|
| | *Males* | *Females* | *Males* | *Females* | | | |
| N | 220 | 22 | 60 | 62 | 740 | 440 | 257 |
| Left-handedness[2] (%) | 13.9 | 15.4 | 24.0 | 10.5 | 9.2 | 9.8 | 9.7 |
| Symptomatic Atopic Disease[3] (%) | 53 | 63 | 53 | 47 | 43 | 35 | 35 |
| Myopia (%) | 50 | 57 | 62 | 70 | 52 | 36 | 20 |
| Age Myopia Was Diagnosed | 9.0 | 8.5 | 8.5 | 7.8 | 15.7 | 9.7 | 9.5 |

[1] Students meeting the criteria for membership in both the verbally precocious and mathematically precocious groups were not included in the tabulations.

[2] Ambidexterity or not fully right-handedness was ignored, although many fit that classification.

[3] Severity of atopic disease was assessed by the following scale: 0 = no history; 1 = isolated event, never recurred; 2 = isolated event, recurred only once; 3 = infrequently recurring problem, not inactive, no longer recurs; 4 = active, ongoing (occurrence at least once a year) problem (mild); 5 = active, ongoing problem (moderate); 6 = active, ongoing problem (severe). *We accepted as a valid allergy only those given a rating of at least 3.*

although they do not constitute proof. It initially seemed confusing, however, that physiological traits characterizing mathematically talented individuals also characterized those who were verbally talented. Verbal ability is considered a left hemisphere function (10, 11, 36). After further consideration, however, our findings might be explained by the fact that we measured verbal *reasoning* ability and the following hypothesis.

It is generally accepted that males receive higher scores on mathematical reasoning tests and that females score higher in certain verbal areas (31). Male fetuses are more frequently exposed to high levels of testosterone than are female fetuses (30). In addition, mathematical reasoning ability is generally believed to be more dependent upon right-hemisphere functions than is verbal reasoning (10, 11, 36, 38). Yet verbal *reasoning* ability, the ability we studied, is probably stronger under the influence of the right hemisphere than language production or syntactical aspects of verbal ability, because verbal reasoning ability involves comprehension and the understanding of difficult words and their relationship [10 (p. 153), 13, 16, 18]. These three sets of findings have the following implications. More mathematically talented males than females and more verbally talented females than males would be identified by existing tests. If testosterone exposure in fetal life does enhance right-hemisphere functioning (19), it might be expected that exposed individuals would have their mathematical reasoning abilities enhanced to a greater extent than their verbal reasoning abilities. Since the right hemisphere is not inactive during verbal reasoning processes, however, verbal reasoning might also be elevated, but to a lesser extent.

Since male fetuses are more frequently exposed to testosterone, the above points or assumptions taken together lead to the following prediction in terms of sex differences. In mathematics even more boys would be talented. In verbal reasoning ability, the relative advantage of girls would be diminished. Consequently, the tests used would identify about equal numbers of females and males who reason exceptionally well verbally, but many more mathematically talented males than females. This is just what was observed by us (5, 8).

Moreover, if the above reasoning was to be correct, there should be a distinct pattern of left-handedness, our indicator of possible prenatal testosterone exposure, among verbally talented males and females and mathematically talented males and females. Among the four groups in this study, the 630V males would be predicted to have the highest proportion of individuals who reached that level because of exposure to testosterone. By contrast, most of the 630V females would have scored at that level for other reasons, but some (a low proportion) would have because of exposure to testosterone. Similarly, many of the 700M boys would be talented for other reasons, but some would have scored at that level because of the testosterone effect. Because males are more frequently exposed to testosterone than females, we predict a higher proportion of such males among the 700M males than such females among the 630V females. Finally, because there would be few mathematically talented females and few would be exposed to testosterone, the proportion of testosterone-exposed individuals in the 700M female group would be somewhere between the 630V females and males, as with the 700M males. In terms of the frequency of left-handedness, the four groups were predicted to be in the following rank order from highest to lowest: 630V males, 700M females and males, and last, 630V females. This was found ($p < .1$). Moreover, the effect of left-handedness and allergies combined also fit the pattern. The 630V males were most likely to exhibit both left-handedness and allergies. Therefore, we can possibly explain our results. The hypothesis needs much testing, of course, as other plausible explanations may also come to mind.

Regardless of the validity of our explanation of the findings, our results on left-handedness have certain implications. Left-handers, ambidextrous individuals, and right-handers with left-handed relatives have generally been found to have different brain organization from right-handers. They are more likely to have bilateral representation of cognitive functions (10, 11, 36), i.e., the specialization of the hemispheres is less marked for language and other cerebral functions. Since about half of the precocious students exhibited signs of bilateralization, as indicated by their or a family member's left-handedness (29 percent and 35 percent of the right-handed and left-handed students, respectively, had a left-handed parent or sibling) and many were not fully right-handed, we propose that bilateral representation of cognitive functions (rather than greater specialization of the hemispheres) is associated with extreme mathematical or verbal reasoning abilities.

The above findings may also relate to the sex difference in extremely high mathematical reasoning ability reported previously (5, 8). We had postulated that sex differences in mathematical reasoning ability may be, *in part*, physiologically determined (5). This did not seem unreasonable since physiological bases for sex-related variation in abilities and behavior have been well documented in other mammalian species, even at the cellular and molecular levels (14). Nevertheless, the current results lend credence to this viewpoint. Yet our data are difficult to reconcile with one endogenous type of explanation of sex differences in cognitive abilities. Our results are not entirely consistent with the hypothesis that boys do better than girls on spatial or mathematical reasoning tasks because males exhibit greater specialization of their hemispheres (see the reviews in 10, 11, and 36).

Onset of myopia *at an early age* also appears to be a characteristic of the extremely gifted. Although environmental factors such as "eyestrain" are possibly involved, it would be remarkable if they were the *sole* cause of this myopia. Many studies have revealed an hereditary component (2–4, 15, 26–28), although environmental stress to the eye has been shown to lead to myopia (e.g., 22). Moreover, the possibility that the higher rate of myopia (and allergies) are due to greater intelligence or perceptiveness of intellectually talented children or their parents seem unlikely. Parents reported for both the intellectually precocious children and for the rest of the family. Nevertheless the intellectually precocious students had a much higher frequency of these conditions than their siblings. Finally, because the pattern of myopia among the extremely precocious was not similar to that found for allergies and handedness, it appears as if they are independent effects. We are, therefore, left with the situation of being able to rule out several explanations, yet not being able to propose an hypothesis.

In conclusion, 80 percent of mathematically and/or verbally extremely precocious students were left-handed, myopic, and/or had allergies. Our results bear on the question: Do intellectual precocity and sex differences in mathematical precocity have physiological as well as environmental bases?

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## NOTES

1. Each score defines the 95th percentile of SAT-M and SAT-V scores of college-bound male 12th graders, who score somewhat higher than such females. This test is designed for those two groups and administered nationally several times per year by the Educational Testing Service of Princeton, NJ 08541. The SAT seems to function far more as a reasoning test for young students than for high school students (5, 8 and 32). The identification procedure is cited in references 5 and 8.
2. The allergy questionnaire was provided by Dr. Franklin Adkinson, The Johns Hopkins School of Medicine at Good Samaritan Hospital, 5601 Loch Raven Blvd., Baltimore, MD 21239
3. The Johns Hopkins regional talent search in 1983 spanned the Northeastern and Mid-Atlantic states and Virginia as well. That year 15,479 seventh grade students already known to be in the top 3 percent on a standardized achievement test were tested. Our comparison group was drawn from this talent search, as were some of our extremely precocious students.
4. Because the left-handedness criterion used excludes ambidextrous individuals, the number who are functional with their left hand may be underestimated by as much as 75 percent.
5. A recent study of a sample of college students found a higher frequency of left-handedness than in earlier studies (35). The authors interpreted their findings to mean that the frequency of left-handedness had increased in recent times. Alternately or additionally, they may have found a higher frequency of left-handedness because they were studying college students, who tend to be at least above average in ability.

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COLLOQUIUM
III

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## The Impact of the Arts on Our Civilization
## Excerpts from Colloquium III

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**Staff:**

*Editor* • Phyllis Miller, 23 Lexington Road, Somerset, NJ 08873

*Production Assistant* • Carrie Martin, 2284 Pressler Road, Akron, OH 08807

*Circulation Manager* • Marilyn Francis, 235 Windmill Court, Bridgewater, NJ 08807

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# Editor's Preface

Every Mensan knows about the excitement and fun of Mensa's AGs and RGs; when you come home from one, you've made new friendships and renewed old ones, and your arms are sore from hugging. Mensa's Colloquia provide the same fun and excitement for your intellectual side, the side that got you into Mensa in the first place.

Colloquium III took place in Louisville, hosted by Kentuckiana Mensa. The theme was The Impact of the Arts on Our Civilization, and the speakers and performers touched on literature, architecture, dance, theatre, language, painting, music, art criticism, and the philosophy of art. Some of the talks were serious, scholarly presentations, others were clearly meant for a popular audience; all were stimulating and thought-provoking.

I chose four of them for inclusion in this issue of the Journal, not because they were the best or the most scholarly or the least scholarly, but because they represent a cross section of the topics presented in Louisville, and they contain interesting new thoughts. Please keep in mind as you read that these articles were given as informal talks, and not as written presentations; the information may be cloaked in casual attire, but it is worthwhile nonetheless.

Phyllis Miller, Editor

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# The Colloquium: How It Came To Be

*by Gabriel Werba*

It all started with one sentence—part of my address to the membership at the 1979 Annual Business Meeting of American Mensa in Kansas City. I was speaking as chairman-elect, of my hopes for Mensa, of my hopes for what it could become.

". . . I want to stimulate within Mensa a climate of intellectual excitement in which concepts can be explored, dialogues can be started, and ideas can be generated that will move us in new directions," I told the membership.

In the 1980 January/February "Comments from the Chairman" column in the Mensa *Bulletin*, I said:

". . . There are members who feel that Mensa has not delivered its promise. Many of them joined Mensa expecting much more in terms of exchange of ideas by lectures, discussions, and other means—as our Constitution promises them—and their expectations haven't been met . . . I suspect that there are hundreds—perhaps thousands—of members who would like to stretch their intelligence, to apply it to the problems our society faces; who feel that there may be more to Mensa than it currently offers, not just to them but to the rest of the world."

Why not an exploration of some of society's problems, I asked. To that end, I proposed the creation of an Annual Colloquium.

It was not to be a replacement for the Annual Gathering, I stressed, nor another Annual Gathering. I proposed a two-day national symposium with panels meeting concurrently to explore a variety of subjects such as America's foreign policy, its fiscal policy, our environmental problems, our productivity problem, energy alternatives, outer space activities and resources, social questions (dealing, for instance, with the aged, the minorities, with the waste of our children's intelligence), and so on.

The first day could be devoted entirely to these concurrent panel discussions—with panelists who are experts in their field (not necessarily Mensans all) presenting brief papers and debating the issues among themselves in the morning, followed by questions and answers from Mensans attending the panels. The second day could be devoted to a large general meeting where the panel moderators could present to the assembly the ideas generated the day before.

I had no idea whether such a conference would work, I said. I had no idea, even, what kind of reception my suggestion would get. For all I knew, it would evoke little enthusiasm. It is quite possible, I said, that little would come of such a conference. After all, a high IQ does not necessarily mean creative thinking or a degree of expertise and competence in specialized fields.

"But," I asked, ". . . what if the interaction of Mensa minds and various experts *did* generate some ideas? What if those ideas *could* be conveyed by means of published transcripts of the proceedings? What if those transcripts *did* act as bases for new stories and articles that could spur further debates—and, perhaps, solutions?

"Would we not at one stroke have served our members and society?"

I invited comments—and I got them. In spades.

Within two weeks of publication of that column, my desk was stacked with letters from all over the country, letters expressing support and enthusiasm. In fact, two cities immediately made bids to host the first Colloquium. Obviously, the idea was one whose time had come.

In the April issue of the *Bulletin*, I continued my written dialogue with the members:

". . . Should the AC address itself to a wide variety of topics, to just a few, or should it concentrate on different aspects of a major problem? Should the AC consist of a number of large forums or numerous small, round-table conferences? Should the panelists be nationally recognized authorities (not necessarily Mensans) or only Mensans? What types of problems should the AC explore?

"There are many other questions to be answered. For instance, if the action of Mensa minds and of various experts did manage to generate ideas that might lead to solutions, shouldn't transcripts of these proceedings be circulated to government, to academia, to the media? If so, what about our constitutional policy that no opinion shall be expressed as being that of Mensa?

"The answer to this may well be that complex problems do not lend themselves to simple solutions, that there cannot be 'a Mensa opinion' on the subject, that—considering the diversity that is typical of Mensa—we will instead end up with numerous ideas suggesting different approaches. Consequently, the transcripts will obviously reflect *not* a Mensa opinion, but *many* opinions representing the thinking of individual members."

At the next meeting of the American Mensa Committee, I asked AMC to recognize Annual and Regional Colloquiums as official Mensa events, which it did. I then named a committee to recommend how we should proceed, which it did. I then set up another committee to organize the first Mensa Annual Colloquium (MAC), which it did.

It all came together Oct. 29–31, 1982, in Boston. A more stimulating, intellectually exciting event in Mensa most of us there had never attended. It was an emotionally charged Woodstock of the mind. We felt in the presence of Mensa history in the making. The overwhelming majority of the people who came were members who had never attended a Mensa meeting before—and they left enthused, walking on air. For months thereafter, I received letter after letter praising the event, urging regional colloquiums and the next Annual Colloquium.

To list all the people who brought the first colloquium to pass is impossible, there were so many of them—hard-working, dedicated. But no chronology would be complete without mentioning then-first vice chairman Roy Saper, who chaired the first committee and laid out the entire structure; Kay Grant, who chaired the second committee and, unbelievably, made it all work; and then-MERF chairman Stuart Friedman and the late Marvin Grosswirth, then past chairman of American Mensa and our public relations officer, who mentored Kay from beginning to end.

And thus was the idea turned into reality.

# Introduction

When Kentuckiana Mensa was asked by MERF to host Colloquium III, we realized the future of these meetings might well depend on our success. We gathered our Colloquium III Planning Committee and speakers over an 18-month period and worked hard during that time to host a successful, organized, conversational conference. We took the challenge seriously. We chose our theme, The Arts, for two excellent reasons. First, this a a field in which Louisville excels. We have an outstanding symphony, as well as nationally recognized opera, theatre and ballet companies; we have five colleges and universities, and exceptional speakers are readily available. Second, the theme was appropriate for a Colloquium, and would appeal to a large audience.

Having hosted two Annual Gatherings and 13 Regionals, we were also well aware of the amenities most Mensans expect. Even at a meeting as serious as a Colloquium, we knew a comfortable area with refreshments was necessary for informal discussions or conversations between members, often continuing into the wee hours. We recognized that while Mensans are good listeners, they want to enter the discussions themselves, so we limited each of the speakers to 20 minutes, followed by 40 minutes for elaboration, questions and discussion. We also knew that all costs must be reasonable if we expected to have a good attendance. We selected the Seelbach, a lovely turn-of-the-century hotel in the heart of downtown Louisville, as the proper setting, but obtained a 60 percent discount on rooms, and affordable chef-planned meals. Members were encouraged to display their own works of art, filling a secured exhibit room in the hotel.

This conference was a departure from Colloquia I and II, and while a few might have preferred a more technical program, those with whom we have spoken or who have written us stated they enjoyed the program immensely. We made a modest profit, which we divided between MERF and our own scholarship program. Our goal was to have a quality Colloquium that would break even; this conference funded itself. Our one regret was that the AMC meetings were, by necessity, in conflict with the Colloquium schedule, and the AMC members were unable to attend any of the speaker programs.

We hope our experience and complete files will contribute to ever better Colloquia in the future.

*Rose Lee B. Crutcher, General Chairman*
Colloquium III

# Literature and Society

*by Dr. William Axton*

**William Axton** is a professor of English at the University of Louisville.

When John Keats wrote "Ode to a Nightingale," the nightingale in that poem was presented simply as a symbol of the poet or the literary person who had no other thought in mind but to unburden his overloaded spirit. Keats pretended to have heard him and wished to join the bird and become what the bird was. A romantic poet is simply trying to express whatever is on his heart. He tried booze to get there first. That's an old tradition, for poetic inspiration arrives when you get stoned. It's partly true; poets are not notably abstemious people. But he decides not to do it that way. Instead, he simply identifies with the poet and suddenly he says, "Already with Thee." Of course, he was already there writing an ode. He had become what the bird was, a romantic poet who simply wrote to express what burdened his heart at a given moment.

Barely 50 years later in the 19th century, Matthew Arnold offered an exactly opposite view of the poet. Poetry was to become, along with all of literature, a kind of surrogate religion. In the age that Matthew Arnold saw it, when belief in the traditional Judeo-Christian structure of thought was no longer possible, when the church was no longer a viable institution for generating cultural unity in the society, in those circumstances he thought literature itself had to stand in the place of religion and offer us consolation and solace and a sense that life has meaning and some sort of order. Literature for Matthew Arnold became a mode by means of which a sort of undefined salvation could be achieved.

A long time ago, a little more than 2000 years, the poet Horace of Rome said that literature should be sweet and useful. It should entertain us and teach us. Maybe that is true. In my own career, I have been reluctant to take many large claims for literature. I've come from an English department which was for many years profoundly influenced by Matthew Arnold and many of Arnold's descendants for whom the notion of literature as a kind of surrogate religion is very important.

I had a lot of fun with my former college. When I first joined the department they asked me what literature was for, and I always said, and I truly believe, that literature is a great way to kill a rainy Saturday afternoon. And to that extent, I think that literature's relationship to the society is a good one. It's good to curl up to John Fowles or David Lodge or whomever on a Saturday afternoon and enjoy yourself. Horace was right, it seems to me.

Literature, like all arts, approaches us on the basis that it will entertain us first. It will amuse us. If it doesn't do that first then it doesn't do its job. Literature is meant to amuse. It doesn't need to be funny but it certainly has to enrapture us in some way.

Literature approaches us on an individual basis, kind of like Victorianism. Victorians thought there was no way to change the world by enacting legislation or large social programs. The only changes that were going to be permanent in the world were going to come from individual hearts. Great Victorian novelists and poets, Dickens, Browning, Tennyson, Eliot, all of them approach the great social problems of their time by making appeals to the individual heart. They felt that when people's attitudes towards their fellow man changed it was possible make any permanent change in society. Like Victorianism, the arts approach people individually rather than collectively.

The arts have attempted, from time to time, to advocate specific programs for social, political, or economic reform, and generally when they have done so they have not been very good art; they have been instruments of propaganda. The artist is neutral. He is not a very moral person. He doesn't really have any palpable intention.

Keats said that the thing about Shakespeare was that he was a genius whose genius consisted of negative capability. He didn't like Wordsworth to write a literature of the egotistical sublime. That is to say, you feel what you feel and you stuff it on nature, and that's what Wordsworth does—nature is great because I have feelings about it and I will endow nature with my feelings; let us all congratulate nature. Keats didn't think so. Keats thought that the great literary artist was the artist like Shakespeare who could as readily identify with Iago as with Othello; who could enter the mind and become the vilest and most despicable villain as easily as and as fully as the finest and most noble hero he ever drew.

From the point of view of society, art is amoral and is, in consequence, a danger; not because it advocates a particular program of social action but because it does, whether it wants to or not, affect the reader's moral nature. By moral nature I don't mean whether you go to church on Sunday or not, whether you shoot up or not, or whether you are an alky or not. I mean, literally, it affects your attitude towards what you think of as desirable and undesirable, beautiful or ugly, good and bad, and all of the rest of the things which affect our behavior. Literature does these things and does them in a very indirect way when it is being literature.

Literature is one of the first ways in which people established some sort of sense of self. There's a good body of thought that indicates most primitive men, when they spoke in any formal way, spoke in poetry. Poetry is the highest form of utterance for a human being, far superior to the novel because poetry makes demands on the language that language is hard put to meet. You can read a novel quite rapidly but reading poetry requires you to duplicate the act of Shakespeare and become one with the poet's words. I think in one sense or another, literature is an essential ingredient of what civilized life began with.

As far as practical purposes are concerned, what you and I know about literature began with, "Baa, baa, black sheep, have you any wool? Yes sir, yes sir, three bags full. One for my master, one for my maid and one for the little girl who lives down the lane." Our earliest experience with the human world is likely to be a poem. It's amazing what a great falling off there is as we grow up and have the misfortune to be educated. Wordsworth put it well: "Shades of a prison house, Close around it." Mature man to Wordsworth, as to Christ, was the man who could recapture his childhood and gain the kind of joy and kind of oneness with the other world outside of ourselves, instead of only getting and spending.

So literature is somehow belly up to what makes us what we are as people and what differentiates us from each other while at the same time offering us a bond of communication. Literature has been used, of course, over the years as instrumentalities of a number of very dubious public projects. We call it propaganda, and so we use and we see it all the time. We are always wary of any form of art in which we can detect what Keats says has a palpable intention on us. He criticized Shelley saying Shelley's poetry tended to want to talk us into some sort of political persuasion. He said Shelley could have been a greater poet if he had been able to restrain his magnanimity. That is a wonderfully ironic and tactful criticism of a poet who was, and would remain even after Keats' death, one of his most valiant defenders and who had helped subsidize Keats until he died. But Keats, being a wonderfully brave man, was not afraid to speak of his benefactor's faults.

Literature is, therefore, a kind of funny enterprise. In many ways it's great, glorious, it has no faults at all. It simply exists to entertain us. It can also be used for tendentious purposes. Literature has been for a long time a great source of information. Poetry was how you remembered things before you could write. The great sages, the great heroic poets of the past, Homer, the author of "Beowulf," were poets who existed before there was a written language and their poetry was poetry that was memorized. Consequently they remain poets who were really passing along information.

The highest ambition literature has is to extend human life beyond current trends and individual experience. This is what we like, whether we recognize it or not, about poetry and fiction. It is a means by which we may engage in as many vicarious lives as there are lives of poetry and characters in novels and by doing so, without its having any palpable design on us, enlarge and enrich and expand and deepen the range of human emotions; and that must have a profound effect on all our lives and on that larger mystical body we call society, of which all our individual lives are but a part.

# Theatre for Young Americans

*by Dr. Moses Goldberg*

**Moses Goldberg** is director of the Louisville Children's Theatre, and an author, playwright, publisher and former university professor.

The topic of this colloquium is the impact of the arts on our civilization. When we talk about the arts and we talk about education, we talk about our society. We raise implicitly the question of *which* society. In the field of education particularly, you can make the case that the function of education is to preserve the current status quo; it is to educate young people to the same values that we educators hold or we taxpayers who pay for the education hold, and therefore, to perpetuate those institutions we find important.

There is another way to approach education, and that is to approach the concept of a different society, a society of a culture we don't even know about yet, one that we don't know how to prepare for. We have the option of saying that the function of education really is to prepare young people for that society. If you make the statement that you're going to prepare young people for a society which doesn't even exist and that we don't even know about, then you are forced into the consideration of how to do it. It is more important to train our young people to make decisions when we don't even know what those decisions are going to be or what the world they're going to face is going to look like; that is the kind of approach that I take to art.

The theatre I direct is a theatre for young audiences. The performers and artists are all adults but we have accepted as our mission to train young audiences to make the decisions they're going to have to make in 20, 30, 40 years. We don't even know what those problems are going to entail. The way we approach this mission is by considering the child as a potential for anything. We make it our business to broaden that child in every area the child can be broadened. For example, if the child has physical ability, we believe the child should be developed to reach his fullest potential as a moving physical being. Many people agree that that is the basis behind our sports programs, not only to find the person who can run the fastest and throw the discus the furthest.

Just as important as training the physical side of the child is training the intellectual side, the social side, and maybe even the spiritual side. There is another component of the structure and intellect which is often neglected in the child, and that is the aesthetic side. Each of us as human beings has the potential for aesthetic development. The arts are nonlogical and occur in the right hemisphere of the brain; even if research proves that not to be true, it is still a very useful concept. There is a function of the intellect, a component of the human mind which is not logical. It is not something that can be trained the same way you would teach someone multiplication. There is a different process, the aesthetic process, and that is one of the things that we are trying to do for the young people.

The concept of doing arts for young people is relatively new. Historically, children went to Greek theatre along with their parents. In Shakespeare's time, apprentices playing hooky from their jobs sat in the back of the pits watching the play, picking up girls, or whatever. There never was the notion that you could develop aesthetically. You were simply exposed to the aesthetics of the prevailing society, which was the adult society. You understood as much as you could and that was it.

Along about 1917-1918, a concept was introduced in the Soviet Union, and the man most responsible for introducing it was Lenin. He had a very strong motive for trying something new because he was faced with a society of Russian peasants who had been serfs only a few years before. Most of them were illiterate. There was very little cultural heritage to speak of. He had to turn them into functioning members of this new socialist state he envisioned. He said, "We will use the arts and we'll build theatres and ballet houses and opera houses in every town in this sprawling country." He had to make sure that they were heated in the winter so that people would have the motivation to go to them. In these buildings he presented the arts and through those arts changed the morality of his society, so that it became a society he could control. "We will know exactly how those people are going to think because we will teach it to them in the arts palaces, in the theatres, and in the ballet houses." Lenin was very successful; he really did create a new social order and a new class of citizens.

Stalin was one of the fundamentalist educators and he wanted to preserve that status quo, but it didn't work. Having said that I am an educator and that one of the things we want to do is change the way people think and prepare them for a society of the future, now I have to tell you that the only way to do that is indirectly. This is what the Soviets are discovering: they can do plays about socialism, values or the October Revolution and the kids will go to sleep. On the other hand, you can entertain. You can engage the emotional participation of the audience. You can really make an effort to empathize with the characters in the story you're telling. You can dazzle them with theatrical effects. You can move them and you can make them care about almost anything you have enough sense to turn into a piece of art. The Soviet Union invented children's theatre and the arts for young people as a social tool. But there people know what is going on in their audiences; they have proven that the only way that you are going to use the arts effectively to change society is by being artists first and educators second.

In this country the people who developed the arts for young people as a separate institution were social workers, working in settlement houses in New York trying to teach immigrant children English. The first play for young minds done in this country was a production of "Tempest" done in 1903. While children had to learn the words to understand the play, the basic movement among social workers was to use the arts to teach manners to children—teach them to brush their teeth, teach them the values of American society. This was about as effective as you would imagine it would be without artistry, but fortunately we're heading towards educating through the artists first and the educators second.

Arts education is really a concept you're going to hear more and more about in the next few years. It is important to understand that it makes several assumptions: one, that we are talking about training children for a society of the future; two, that we're talking about developing the child to reach his fullest potential aesthetically as well as intellectually as well as physically; and finally, that we're putting the priority on artistry so that when the child goes into the theatre, the ballet hall or the symphony hall, he is going to be moved. He is going to be entertained. He is going to care about the experience he is having, and through that process we want to shape a society of the future—but are we smart enough to know how we want to shape it?

# The American Language

*by Dr. Al Futrell*

**Al Futrell** is an assistant professor in the Department of Communications at the University of Louisville.

You've been told that I am studying subcultures, but you haven't been told which subcultures I am studying. I guess it's time to let the cat out of the bag and say specifically that I am studying the subcultures of criminals. I got my start in this field by doing an apprenticeship with a man who was probably the top authority in the world on the subject, even though he was actually a professor of literature: David Maurer. He originally got in touch with me as a subject for one of his interviews. I was hanging around pool halls a lot. He said that we spoke the same language, and he decided to attempt to teach me how to write and how to talk. He was semi-successful, I suppose.

Now what I'm doing is trying to carry on the same type of research he did in studying the language of subcultures, specifically criminal subcultures. What I will talk about is new words. Many of them come from criminal subcultures. Stuart Fletcher, whom William Safire has called America's Slang King and who once held the same apprenticeship I did with Maurer, has pointed out that the criminal subcultures contribute to mainstream language in an inordinate fashion. The influence they *should* have and the importance they *do* have in American language are in inverse proportion.

A large part of our mainstream language comes from the criminal subcultures. What's important about this to me, since I call myself a sociolinguist, is that there is a connection between language and behavior. Right now I'm involved in a project trying to mesh behavior patterns with language patterns and discover some of these new words. What happens is that when there is an increased interest in the subculture by the mainstream or dominant culture, then words in that subculture tend to merge into the dominant culture. As an example, terms such as "hit," "crash," "pad," "strung out," and so on, you will recognize as drug terms. A pet theory of mine is that when the language diffuses, oftentimes the behavior pattern does as well. The drug subculture is especially interesting since we can trace it to its beginning. In 1914 the Harrison Narcotic Act made the drug subculture a criminal subculture overnight. By the 1930's these terms were used, but they were very secretive: you didn't hear people using drug terms unless they had something to do with drugs. Today, I hear a lot of students use drug terms and I don't believe that all of them are using drugs. They don't realize that the terms are drug related. I think what happened is that these terms have diffused out of the subculture into the mainstream. This is one way to look at the drug problem. What happens is that when the terms are used the behavior diffuses. The combination creates what I call a context of comfort. I have this idea that the context of two people interacting is built upon the language they are using and if you know all the terms that are being used you feel very comfortable in that context.

Some terms such as "ante," "blue chip," and "raise the stakes" were once exclusively gambling terms but are now used as a matter of course in nongambling contexts. In the newspaper last night there was a cartoon about three presidents who had "a square deal," "a fair deal," and "a new deal." These are all gambling terms raised to such a level of legitimacy that presidents could use them. I would say that this is the case of totally internalizing a metaphor, so that we ultimately forget they are gambling terms at all. I think this same thing happens in contemporary America with drug terms. The gambling behavior has diffused with the language, so the drug behavior may also diffuse or is, in fact, in the process of diffusing.

Maurer once pointed out to me that he thought there were four things that happened as new words come from the underworld and diffuse. One is that they just drop and people quit using them. One is that they rise to respectability. One is that remain in the underworld. The fourth is that they become slang, an informal type of language that is not acceptable in formal situations. The words have a tendency to stay around, it seems. Mauer's favorite example was the word "pig" for policeman. In 1785 a dictionary published in England by Sir Francis Gross called the *Dictionary of the Vulgar Tongue* gave one definition of "pig" as being a China Street policeman. It appears that the term "pig" for policeman, then, did not originate in the 1950's or 60's, but was being used, at least in the underworld, since the 1700's. This was an example of a term that hung around.

Some terms we still find in the pickpocket language are "tool" and "stall," which are being used today just as they were in 1590. The mainstream population didn't and doesn't know what they mean. A "stall" is the one who delays the person and the "tool" actually picks the victim's pocket. These terms have persisted for two reasons. One is that the technology of pickpocketing has not changed too much. The other is that there seems to be a connection between the diffusion and the amount of interaction with the mainstream. The pickpockets don't generally talk to the mainstream. In contrast, a confidence man has to get your "confidence" so he *has* to talk to you. In contemporary society, it is often hard to tell the difference between the con man and the legitimate businessman. Their language styles and strategies, as well as their lexicon, are very similar.

The con man is actually a good example of technology affecting a criminal subculture. Take Ben Jonson's 1690 play, "The Alchemist," in which alchemy was used to con people out of their money. The exact same story is told in the movie "The Sting," which, by the way, was based on a book Maurer wrote in 1940. Redford and Newman's characters used the same 10 steps to rip off their mark as did Jonson's Face and Subtle, the difference being the former used a telegraph and horse race instead of alchemy. More contemporary con men use stocks or real estate. They change the nature of the crime as technology and culture change, but they still play to the same human weakness of getting something for nothing.

Drug terminology is a case of going from a tight subculture to a loose subculture, from a little interaction to a great deal of interaction. Consequently, you see a great deal of confusion, which is what I think we're seeing now among many youths.

Thus, what we have here are three basic examples of subcultures in different stages of diffusion. The pickpocket subculture remains tight. The con man's is loose, and the drug user's is in the process of going from tight to loose. The language of the three reflects this social distance from the mainstream culture. The pickpocket argot appears to be the most esoteric, the con man's appears to be that of the mainstream business types, and the drug addict's is becoming less and less foreign to most of us.

So that I won't sound too pessimistic, let me share a few colorful examples of new words. Consider first slang that remains slang. One term, "crack," is now known as a type of drug, but it wasn't a drug term in the 1700's. "Crack" used to mean whore and still does to some people. One of the terms I ran across is "peach." For the public it meant a pretty girl, especially one who was sexually attractive. To prisoners it meant a "snitch." Take the word "stir." A guy will say, "I did three years in stir." I found that it is an Anglo Saxon term, "steor," which meant punishment—so it actually never has changed meaning. Another term used in the Middle Ages, meaning to break free of confinement, was "spring," and criminals still use that term in exactly the same way. Some of these terms, as you can see, have very long histories. I sometimes feel kind of stupid thinking I've discovered a new term only to find that Chaucer used it!

Some terms have gone from slang to respectability. A paradigm case of this is the term "fence," a receiver of stolen goods or, as a verb, to buy stolen goods and to sell them. I don't know of any term in standard English that we can use to replace this one. Another term that was used among criminals was the term "quota," which meant a share of the stake. "Straightlaced" is another term that used to be used among criminal subcultures to mean overly nice.

Then we have some terms that originated in criminal subcultures and are still used there. A complaint to the police is a "beef," which comes from rhyming slang. If a guy had just stolen something from you and he's running down the street, then the cry was, "Hot beef a thief," which has simply been clipped back to "beef." Noncriminals use it in a similar fashion to mean a complaint, but there is clearly a subtle difference in the meaning when used by a criminal and by a law-abiding citizen. When terms diffuse, the meanings do not always accompany them. "Ding," for example is still used among criminals to mean knock somebody down. In prison it also means somebody who is crazy, or who is a moron, a meaning which in some domains has diffused to the mainstream.

A "peter" is a safe, and this term goes back to Shakespeare's time. "Punk," which also goes back to Shakespeare's time, refers to someone who is homosexual or serves some master. Shakespeare used it to mean prostitute. Since young boys used to play the female roles in plays during Shakespeare's day, the association of a young boy as a sexual partner for men follows logically. Up into the 20th century, young male homosexuals were referred to as "punks." In hobo lingo, "punk" referred to a young male traveling companion. In mainstream lingo, "punk" has taken on several meanings, including a type of esoteric contemporary music.

One time I used the term "bad" to mean "good," and the prisoner I was interviewing said they don't use that term anymore. Now they use "down." He gave 24 definitions for the word. Some examples include "Mike is a down dude," "The Seville is the downest car ever," and "William is down for the dollar." I first heard this expression when a student came into my classroom and said, "I'm down for this test." I thought that he was depressed about it when he was really ready for it! When prisoners go to the parole board they substitute the term "up" for the word "down." One prisoner said, "A man must be down so he'll be down to go up." Someone once told me that prisoners don't speak English in prison, but of course they do. The problem is that nonprisoners typically don't have any sense of the prison context within which this English is spoken.

One of the things that happens to people who do this type of research is that journal editors, who have not done the research themselves, tend to think that you are off base. They rarely have any reservations about telling me that I have the wrong definition for a term. An example of this is my experience with the term "shark." "Shark" has traditionally been associated with pool halls, even though it has also been defined as a type of pickpocket or an astute poker player. In most people's minds, a "pool shark" is a great pool player, but that is not always the case. In the pool subculture, there are at least three levels of skill as well as three levels of language usage. There is an inner core, "players" who make a living playing the game; there are peripherals, people who hang around pool halls but are not really good pool players; and there is an outer layer generally referred to by the inner core as "fun players," who play not for profit but for the sport. In the inner core a "shark" is someone who is adept at psyching out his opponent, but not necessarily someone who is a great pool player. Since these guys are always playing for money, the shark is likely to win quite often. But it is not because of his skill at playing so much as his skill at "sharking." If an interloper misuses the term, the "players" know he is not part of the in-group. So one's language usage serves to place him in his proper place in the hierarchy. The context is created by the language usage, and one thing that enables the researcher to get deeper into the subculture is an intimate involvement with the context-producing facility of that subculture, namely the language of the participants.

The whole idea informing my studying the language of non-mainstream subcultures is to understand the day-to-day interactions of these people through their language use. One quickly discerns that these people are often masters at applied psychology and linguistics. They do many things naturally, and what they do has a great influence on American language and, by extension, American culture.

# The Effects of Art: Good and Bad

*by Charles Breslin*

**Charles Breslin** is on the faculty of the Department of Philosophy at the University of Louisville.

I appreciate the opportunity to speak with you today and I've chosen what is certainly an impossible subject, having to do with the relation between art and virtue.

We should affirm at the very beginning that not everybody likes art. Dr. Samuel Johnson, you may remember, was approached by a woman who said, "I understand that you don't like music." "On the contrary," he said, "of all the forms of noise I find it the least disagreeable." I think we have to say something about the importance of art from the standpoint of the great moralists who have addressed it correctly, or, in fact, practiced it: Tolstoy, Freud, Thomas Mann, Murdoch. Mondelstam once said that the Soviet Union is one of the very few places that takes poetry seriously: people kill you for it. This is hardly an exaggeration. If sections of truth that can be obtained in art can cause your incarceration in other parts of the world, then we indeed wonder about that insurance, that sense that in America everything is possible and nothing is important and in the Soviet Union everything is important and nothing is possible.

This touches the question of art as well. When Youfolsh said in one of his three volumes about poetry that poetry touches the very heart of human endeavor, he spoke about that from experience, and I submit that Americans, though perhaps only indirectly, are cultural commissars. Grossman was told that his work, "The Light of Faith," could not be read for 200 years because they perceived the truth of it in a particular sense indeed. Why, for instance, in the Soviet Union, at least in the 1950's and 60's, would abstract art be anathema? Why would music and modern fiction be anathema? What difference could it possibly make, we must ask ourselves. We ask Plato's question, what are devils in relation to art and virtue or art and goodness?

Iris Murdoch has dealt with those questions as interestingly as anyone I know. We look at her answer to the question, what is the power of art that makes it the most fundamental kind of protest that human sensibility abides in any imaginable kind of world? Theoreticians have tried to explain this. Warringa talked about the trust a person would have to have in the world in order to produce classical art in any sense. If you break that trust and you experience alienation and isolation and fear and hostility, then art turns abstract and it's a vast refuge from ideology. This explains only so much and no more. I mention these remarks at the outset to affirm my very strong belief in the proposition that art is the most significant form of development in human life.

Robert Penn Warren's essays on democracy aver that poetry takes up a similar theme. It's poetry that speaks inherently to the inward darkness of our fate. As an example, I mention that art has something to do with fantasy and how fantasy in the Freudian sense brings a very pejorative concern when you relate it to virtue. Freud says, "The writer softens the egotistical character of the daydream by changes and he bribes us by an offer of aesthetic pleasure in the presentation of his fantasies." Freud will turn again to that aesthetic drive, if you wish, and favor virtue because it seems that human life is fundamentally tolerable only to the extent that we can recognize transgressions and interdictions or prohibitions, and in part helps and hinders that nature depending on the "character of art itself."

"The most fundamental aspect of culture is the study of literature, since this is an education in how to predict and understand human situations," Murdoch wrote. "We are human beings and moral agents before we are scientists." Remember how C.P. Snow put this in 1950: the so called two-culture controversy that states there is something wrong with you if you cannot formulate the second law of thermodynamics. This is why Murdoch says it's "more important to know about Shakespeare than about any scientist, and if there is a Shakespeare scientist his name is Aristotle," the metaphysician of the human mind, the philosopher who believed that, like Robert Penn Warren, God loves the world just the way it is; that is to say, between, beyond, and inspired by our fantasies. The arts, especially literature, show us the absolute pointlessness of virtue while exhibiting its supreme importance.

"The pointlessness of art is not the pointlessness of a game; it is the pointlessness of human life itself," Murdoch has written. Form in art is properly the stimulation of self-contained aimlessness of the human urge. We might not like the metaphysics implied in that, and this, too, would require a defense. If we argue for the inherent value of art, good art, we feel, is what we are too timid or too selfish to recognize. This is what Joseph Conrad had in mind in that famous preface to one of his novels: "The purpose of writing is to enable us to see what we are ordinarily blind to in so many ways, enable us to see lucidly and unblinkingly." This form often seems to us mysterious because it "resists the easy patterns of fantasy, the proliferation of blinding, self-centered images," Murdoch said. That's what I mean by fantasy as an innocuous or happy affair.

So when we stumble into bookstores and buy those romances, is that all right as a stratagem for living? Who is to say it is and who is to say it isn't. "Good art shows us how difficult it is to be objective by showing us how differently the world looks to an objective vision. We're presented with a truthful image of the human condition in a form that can be contemplated and, indeed, this is the only context in which any of us are capable of contemplating it at all. Art transcends selfish and obsessive limitations of personality. Good art teaches us how real things can be looked at and loved without being seized, without being appropriated by the greedy organism of the self. Beauty is that which attracts this sort of unselfish tension," Murdoch wrote. "Any story we tell about ourselves consoles us since it imposes pattern on something which otherwise would be perceived as intolerably chancy and incomplete. However, life is chancy and incomplete, and if there is any consolation it is the austere consolation of beauty that teaches that nothing in life is of any value except in the attempt to be virtuous."

Mann says that to be pleasing in the eyes of God one must be willing to subject oneself to a morally more adequate future and not live currently. That is probably very Hegelian in its origin but very consistent with the notion of virtue as a projective enterprise, certainly in our culture. Art, then, is not a diversion. It's the most educational of all human activity, in which the place or nature or morality can be seen.

"Understanding any art involves the recognition of hierarchy of authority." Good art is something preeminent outside us and resistant to our consciousness. We surrender ourselves to the authority with a love that is unpossessive and unselfish. Art shows us the only sense whose determinant is incorruptible and reveals to us aspects of our world which our ordinary dream consciousness is unable to see," according to Murdoch. In platonic language, "art pierces the veil and gives sense to the notion of reality which lies beyond appearance; it exhibits virtue." In its true guise, art presents the most comprehensible example of the irresistible human tendency to seek consolation in fantasy and also the effort to resist it, the condition of reality which comes from successful effort. Success is, in fact, rare. Most use art as magic. Auden says only "the very greatest art invigorates without consoling and defeats our attempts to use it as magic."

"The greatest art is impersonal because it shows us the world, our world and not another one, with a clarity which startles and delights us simply because we're not used to looking at the world at all," says Murdoch; hence Conrad's emphasis on seeing. What is learned from contemplating with Shakespeare is something about the real quality of human nature when it is encouraged. We see art "with a clarity which does not belong with the self-centered rush of ordinary life."

In conclusion, "art will mediate and adorn and will later develop magical structures to conceal the absence of God," Murdoch believes. Hegel was wrong where art is concerned when he said all has worked itself out and the form of truth in the modern world will be science and not art. As religion and metaphysics withdraw from the embraces of art as Hegel prophesied, we are, as Murdoch said, "being forced to become mystics through the lack of any imagery. . . . Sophistry and magic may break down but they never go away; there is never an end to their collusion with art. Perhaps fortunately for the human race, they can collide and art goes on existing."

# A Direct Communication

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**Staff:**

*Editor* • Phyllis Miller, 23 Lexington Road, Somerset, NJ 08873

*Production Assistant* • Carrie Martin, 2284 Pressler Road, Akron, OH 08807

*Circulation Manager* • Marilyn Francis, 235 Windmill Court, Bridgewater, NJ 08807

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# Editor's Preface

"Controversy?" the Journal advisors asked with delight; "Go for it!"

After all, one of the purposes of the *Mensa Research Journal* is to stimulate discussion, and if a resesarch paper on what might be seen as a controversial topic can't stir debate among Mensans, we're in the wrong organization. (Just think how much debate there is among Mensans on noncontroversial topics!)

So, herewith we present an entire issue devoted to the work of Richard Lynn, a professor at the University of Ulster at Coleraine whose research papers in the field of comparative intelligence have been consistent winners in the MERF Awards for Excellence competitions. When we told Professor Lynn we would be using some of his past papers in the *Journal*, he suggested instead that we use his newest paper, one which combines and expands upon his previous works and develops a synthesis of previous findings and theories. This is a major work, and we are really proud to be able to present it to our readers.

Professor Lynn agreed that the work might be controversial, and has asked colleagues in the field to comment upon it. Issue 24 of the Journal will include those comments, rebuttals by Professor Lynn and, I hope, letters to the editor from our readers.

Three words of caution:

1. Don't be misled by the use of the word "Mongoloid." In American usage, it is frequently associated with Down's Syndrome. In the rest of the world, and certainly in this paper, it refers to certain east Asians.
2. First read the preliminary article by Cecil Reynolds. It will enhance your reading of the Lynn article, and either ignite or douse certain passions.
3. If your subscription runs out with this issue, make sure you renew in time to get #24!

Phyllis Miller
Editor

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# Race Differences in Intelligence: Why the Controversy?

*Cecil R. Reynolds*

**Cecil R. Reynolds** is a Professor of Educational Psychology at Texas A&M University.

Differential psychology, or the psychology of individual differences as it is better known, is the most important of the basic psychological sciences. The study of how individuals and groups differ on such key constructs as intelligence and personality variables of one sort or another ultimately forms the basis for not only theory in psychology, but the development of intervention programs and psychologically based treatments. The now-past age of behaviorism all but ignored individual differences, and work in the study of individual differences even fell into some disrepute. Despite the latter influences, work in the field did continue, much of it controversial, as reflected in the publications of Arthur Jensen and Richard Herrnstein during the late 1960s and early 1970s and the subsequent events surrounding their work. Both were picketed and shouted down during presentations at conventions (mostly by outside agitators and not other scholars attending such meetings). As recently as 1981, Jensen's life was threatened prior to an invited address at the annual meeting of the American Psychological Association. Research on individual differences nevertheless has undergone a major resurgence in the late 1980s. New psychometric methods for the study of individual differences have been devised, cognitive science has given us new paradigms for study, and the tremendous advances in neuropsychology of the last 15 years have made the brain fair game once again for psychologists (e.g., see Reynolds and Willson, 1985).

The tremendous controversies that have been reignited as a result of the expansive research on individual differences are anchored in race differences in performance on standardized tests of intelligence and interpretation of those differences. Traditionally, the difference that gets the most attention and the most (and most polemic) debate is the well documented discrepancy of about 1 standard deviation (about 15 points on most intelligence tests) between Blacks and Whites (favoring Whites) in the United States. Equally well known to researchers and scholars in the field are differences in level and pattern of intellectual abilities among not only Blacks and Whites, but Whites and other racial and ethnic groups such as Hispanics, Eskimos, Native American Indians, and the Asian or Mongoloid groups (e.g., see Reynolds and Brown, 1984).

Four major paradigms exist for the explanation of the differences in performance among the various race and ethnic groups. The first of these, the environmental hypotheses, argue that the differences can be attributed to differing cultural emphases in child-rearing and educational arenas, that all groups have equipotentiality for development of the full range of human abilities at comparable levels and within the same temporal context. The second view is the genetic view, which argues that the natural endowment of groups differs and these genetic differences are responsible for the differential propensities of the different races. The third, and most popular, view is the nature-nurture interaction paradigm, which is also the fundamental view of Richard Lynn's article but placed into an evolutionary perspective. The interactionist view is essentially that the genetic predispositions of groups may differ, and likely do, but the manifestations of those differences are largely dependent upon environmental determinants. The fourth view, known as the cultural test bias hypothesis, is simply that tests of human abilities cannot be applied cross-culturally or even extended to subcultures of a single dominant culture. Consequently, all groups are not only equally endowed but develop simultaneously, and any differences that appear are an artifact of flawed methods of psychological testing because, in reality, there can be no differences in intellectual ability across groups (including male-female differences.)

Support for the latter view has been mostly vitriolic with regard to intelligence tests, yet without empirical support. Among most psychometricians (those who study tests and the methods of testing) the cultural test bias hypothesis has fallen largely into disfavor. Empirical and theoretical refutations of the view are many and are reviewed extensively in Jensen (1980), Reynolds (1982), and Reynolds and Brown (1984). We are thus left with the nature, nurture and interactionist views.

In proposing an interactionist view that emphasizes genetic change, promoting a long-term evolutionary perspective, Lynn has taken a bold step, but one that will not avoid the polemic outcries that accompany such research. In reading Lynn's treatise, it may be useful to defuse the emotional issues so that its scientific merits can be evaluated more carefully and objectively. The reader may thus wish to keep the following in mind while reading Lynn's work.

Lynn develops a model of the genetic evolution of intelligence that results in differences in level and patterns of intellectual abilities between certain of the east Asian races denoted as Mongoloids, and western White or Caucasian races. These differences occurred as a result of the demands of radically opposed environments. Traditionally, any such view has been taken, albeit superficially, as a genetic view of race differences; it is not, and is better cast as an interactionist paradigm, placed into evolutionary perspective. If viewed as an entirely genetic explanation, Lynn's paper could then fall to the fate of certain other legitimate attempts to understand race differences in intelligence. Such theories have, historically, been misused, abused and mostly misinterpreted to support the oppression of women and members of a variety of racial and ethnic groups (e.g., see chapter 1 of Reynolds and Brown, 1984, for a review).

However, note that Lynn and others before him discuss differences, not deficits as they are so often interpreted. To borrow from the well reasoned writings of the great geneticist Theodosius Dobzhansky, whose views were reinforced by the eminent educational psychologist E. Paul Torrance, "dif-

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ferences are not deficits." We should, in fact, rejoice in the extent of human differences and treat them for what they represent, a wonderful diversity of adaptation of the human species.

Lynn also is not writing about individual members of any particular race. It is well known and often stated that there are far more within-group differences than between-group differences among the various races. What this means to the controversies and emotional debate engendered by research on race differences is twofold: the range of differences in pattern and level of mental abilities within a racial group is far larger than any such differences between any two (or more) groups, and that race or ethnic status is a very poor predictor of the mental abilities of an individual such that one cannot generalize accurately from group data to any individual member of the group.

Lynn also does not propose, as he may be interpreted, that what is always shall be. In fact, he proposes just the opposite. According to Lynn's view, human mental abilities are capable of relatively rapid (in evolutionary or archaeological time) genetic change as the demands of the environment are altered. There is nothing to prevent drastic shifts in the pattern of human abilities across time.

By virtue of learning about the nature, nurture, and mechanisms of interaction of the genetic basis of intelligence with the human ecology, we may be able to create changes in more predictable directions. Such concentrated efforts may be inadvisable, but without the knowledge there can be no choice.

The neurological data reviewed and the theoretical position of Lynn on the neuropsychological basis of intelligence is largely consistent with my own views (e.g., see Reynolds, 1981). However, Lynn does a great service by integrating neurology with more fundamental biology and psychology of adaptation and change and in a way that will yield testable hypotheses. Herein lies the strength of Lynn's work. Whether he is "right or wrong" is irrelevant to the science of individual differences. That he has provided a strong and testable theory that will lead to new discovery is important.

There are many specific points with which to take issue in Lynn's paper. For example, he argues that Mongoloids perform higher on measures of "g," the general factor of intelligence, and also on nonverbal, visuospatial tests of mental skill. He also treats these two events as independent. They are not. An alternative interpretation would be that, since visuospatial tasks tend to be more highly correlated with g than, say, short term memory or verbal tasks, the higher g of Mongoloids causes the higher levels of performance on visuospatial tasks or vice versa. In any case, the dual elevations of performance would be a mathematical artifact of the obliqueness of the two constructs. My advice is not to be distracted from the larger implications of the paper by the numerous points of data that could have alternative interpretations. Focus on the larger paradigm and its implications for the study of human differences. Not even the fact that Lynn espouses his theory on the basis of Mongoloid-Caucasian differences is of great importance. What is important is the paradigm it introduces and its testability.

Lynn's work and its appearance in the *Mensa Research Journal* will undoubtedly spur commentary, and this is as it should be. Hopefully the commentary will add to the scientific scrutiny of Lynn's paradigm and not to the rhetoric of emotionality that accompanies this field or to the pseudoscientific application of Lynn's work to the promotion of bigotry in society. It is perhaps propitious that Lynn did choose to illustrate his view with the Mongoloid race, and it will be interesting to gauge the responses his work will generate against work assessing other race differences that have gone before.

You may find it of some interest to observe your own responses to Lynn's work and gauge their emotionality and their objectivity where each occurs. Read on; you are sure to find much of interest, and for everyone something to agree with and something with which to disagree.

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# The Intelligence of the Mongoloids: A Psychometric, Evolutionary and Neurological Theory*

*Richard Lynn*

**Richard Lynn**, Department of Psychology, University of Ulster, Coleraine, Northern Ireland

## SUMMARY

This paper presents a theory of the intelligence of the Mongoloids consisting of three linked sub-theories. The first concerns the psychometric features of Mongoloid intelligence and proposes that Mongoloids are characterized by high general intelligence (Spearman's g), high visuospatial abilities and low verbal abilities. Mongoloid abilities also display a slow maturation in infancy and early childhood. It is proposed that this pattern of abilities cannot be explained in environmental terms and should be regarded as substantially genetically programmed. The second sub-theory presents an evolutionary explanation for this pattern of abilities in Mongoloids, whereby it is proposed that the extreme cold of the ice ages acted as a selection pressure for increases in Spearman's g and the visuospatial abilities. The low verbal abilities and slow maturation rates are interpreted as by-products of these adaptations. The third sub-theory presents a neurological model for the Mongoloid brain in which it is proposed that cortex devoted to the visuospatial abilities was expanded at the expense of the cortex devoted to the verbal abilities. The implication that there exists a negative correlation between the visuospatial abilities and the verbal abilities is considered in the concluding part of the paper and shown to be correct.

## INTRODUCTION

During the last two decades there has been a considerable amount of serious work on the problem of racial differences in intelligence. Nevertheless, this work has been characterized by four weaknesses. Firstly, the data on which the rival environmental and genetic theories have been built have consisted largely, although not entirely, of differences in mean IQ between Blacks and Whites (hereafter Negroids and Caucasoids) in the United States. Secondly, these differences have been expressed largely, although again not entirely, as differences in a single overall IQ rather than

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as differences in patterns of narrower abilities. Thirdly, if there are genetic differences between races, these must have arisen through differential selection pressures operating in the course of evolution to produce the observed differences in intelligence. A complete genetic theory should provide an explanation concerning the nature of these differential selection pressures and show how they have brought about the differences in intelligence between the races, and yet no such explanation has been proposed. Fourthly, if differential selection pressures for intelligence have indeed been present, they must have resulted in different neurological structures or functions in the brain of the respective races, and here, too, no theory of the nature of these neurological structures has been proposed.

It is our objective in this paper to advance this field of inquiry in all four of these respects. The paper is concerned primarily with the intelligence of the Mongoloids because the intelligence of this major race has been a relatively neglected issue and the intelligence of the Mongoloids provides a considerable extension of the data base from which theories of racial differences in intelligence can be constructed. The scope of the arguments presented in the paper is now briefly sketched. In Part 1 a fairly extensive account is given of the intelligence of the Mongoloids. We shall see that Mongoloids in Japan and the United States, and to some degree in other states of the Far East, have a distinctive type of intelligence, consisting most notably of high general intelligence (Spearman's g), and a low verbal-high visuospatial pattern of abilities. In Part 2 we consider environmental theories of the Mongoloid-Caucasoid differences and conclude that it is not possible to construct an environmental theory capable of explaining the data. Part 3 considers the alternative genetic theory of Mongoloid intelligence. Part 4 presents an evolutionary theory to explain the principal features of the abilities of the Mongoloids. Part 5 presents a neurological theory of the different brain structures in Mongoloids and Caucasoids. Part 6 deals with a problem which arises during the exposition of the theory (namely that during the course of the evolution of the hominids there must have developed a negative association between the verbal and visuospatial abilities) and the psychometric evidence is presented to show that this is the case. Part 7 concludes the paper with a summary of the principal propositions of the theory.

## I. THE INTELLIGENCE OF MONGOLOIDS

The Mongoloid peoples are those whose original habitat was Northeast Asia, north of the Himalayas and east of the Urals (Bodmer and Cavalli-Sforza, 1976). Their distinctive physiognomy evolved as adaptations to conditions in this part of the world. For practical purposes the Mongoloids are largely the Chinese and Japanese, and we start with a review and synthesis of the intelligence of these peoples in Japan, the United States and the three Far East nations of Hong Kong, Singapore and Taiwan.

The intelligence of different populations is often expressed as a single mean IQ. The single IQ is itself an average of tests of a variety of verbal, reasoning, spatial, perceptual, memory and other cognitive abilities, and in many cases it expresses adequately the mean cognitive ability of a population. For instance, both male-female differences and Caucasoid-Negroid differences are quite well represented by a single IQ, although there are in addition more subtle differences such as the well known tendency of males towards superiority on visuospatial tasks and of females towards superiority in immediate verbal memory and word fluency (Maccoby and Jacklin, 1974; Jensen and Reynolds, 1983).

In the case of Mongoloids, however, a single IQ does not capture at all adequately the significant features of their intelligence. The intelligence of Mongoloids differs from that of Caucasoids more in the pattern or profile of their abilities than in the overall IQ. To describe adequately the Mongoloid pattern of abilities it is necessary to express them in terms of a more complex model of intelligence. For this purpose we use the Burt-Vernon hierarchical model, first proposed by Burt (1949) and Vernon (1950) and the paradigm for the structure of intelligence that commands general acceptance among leading contemporary students in this field (see, e.g., Eysenck, 1979; Vernon, 1979; Jensen, 1980; Undheim, 1981; Gustafsson, 1984).

The hierarchical model consists firstly of a general factor identified as general intelligence or Spearman's g. This factor embraces all cognitive abilities and is responsible for their positive intercorrelation, as Spearman (1904) originally proposed. The purest measure of Spearman's g consists of abstract reasoning tests such as Raven's Progressive Matrices (e.g. Jensen, 1980; Gustafsson, 1984). Spearman's g may well be represented neurologically by the overall size of the brain or its general neural efficiency in the analysis and storage of information, as proposed by Eysenck (1982).

At the second level in the hierarchical model, Spearman's g is divided into two group factors. These were originally designated by the British factorists the verbal-education (v-ed) and the spatial-mechanical (k-m) factors. This nomenclature has not received universal acceptance and is for various reasons unsatisfactory. We prefer the terms verbal and visuospatial abilities. In neurological terms these two groups of abilities are, broadly, localized in the left and right cerebral hemispheres and the significance of this fact will be discussed more fully in Part 5 of this paper when we consider the neurology of the Mongoloid brain.

At the third level of the hierarchical model are found a number of primary abilities. Six of these primary abilities were originally conceptualized by Thurstone (1938). Over the last half century their number has grown and there are now some 30 in the combined lists given by Cattell (1971) and Ekstrom, French and Harman (1976). These primaries are of two kinds. Firstly, many of them are finer components of the broad verbal and visuospatial group factors. Thus the verbal group factor can be split down into the primaries of verbal comprehension (vocabulary, etc.), number ability (mental arithmetic), long term verbal memory (verbal fluency), and immediate verbal memory (digit span). Similarly, the visuospatial group factors can be split down into primaries of spatial visualization (maze tests), spatial orientation (tests of rotating three dimensional shapes), drawing ability and flexibility of closure (the Embedded Figures Test).

In addition there are further primary abilities which do not belong to either of the verbal or visuospatial groups. These include abstract reasoning, the closest measure available of Spearman's g, the musical primaries, ideational fluency and other miscellaneous primaries. The most sophisticated recent factorial work on the hierarchical model of abilities is that carried out by the Swedish factorists Undheim (1981) and Gustafsson (1984), whose refined version of the Burt-Vernon model is followed in this paper.

The remainder of this part of the paper is concerned with the quantification of the intelligence of the Mongoloids in terms of the hierarchical model. We shall see that the Mongoloids are superior to the Caucasoids with regard to Spearman's g, the visuospatial group factor, and the visuospatial primaries, but inferior to Caucasoids with regard to the verbal group factor and the verbal primaries. This pattern of abilities is shown in turn for Mongoloids in Japan, in the United States and, to some degree, in Southeast Asia. It is also seen that Mongoloids tend to develop more slowly in infancy and early childhood than Caucasoids.

## 1. The intelligence of the Japanese: Three definitive studies

The intelligence of the Japanese is best considered first in terms of three definitive studies, from which values for the principal Japanese abilities can be calculated. A number of other studies, to be reviewed in the next section, can then be assimilated into this structure. The three definitive studies are the Japanese standardizations of the American McCarthy Scales of Children's Abilities, covering the age range 2½-8½ years; the Wechsler Preschool and Primary Scale of Intelligence, covering the age range 4-6 years; and the Wechsler Intelligence Scale for Children-Revised, covering the age range 6-16 years. Full details of the Japanese standardizations of these three tests and the calculation of Japanese values for general intelligence, the verbal and visuospatial group factors and a number of primary abilities are given in Lynn and Hampson (1986a, b and c). What is given here and shown in Table 1 is a summary of these values given in these three studies.

Before discussing the details of these Japanese abilities, several points need to be made. Firstly, all the values are calculated as mean IQs for Japanese children set in relation to means of 100 and standard deviations of 15 for American Caucasoid children. This has entailed statistical adjustments to remove the effects of Negroids on the means of the American standardization samples. Secondly, all Japanese IQs are adjusted for the differences in dates between the standardizations in Japan and the United States. The Japanese standardizations were carried out later than the American, and mean population IQs have shown secular increases in both countries (Lynn and Hampson, 1986d). Hence to compare Japanese and American means for any given year the Japanese means need to be reduced to allow for the later dates of the standardizations in Japan. These two adjustments to the values for Japanese IQs are designated "race and time adjusted" in subsequent discussions of the calculations of Japanese abilities. Thirdly, indices of factor comparison show that the tests are measuring the same factors in the two populations. Fourthly, the Japanese and American values for Spearman's g and the verbal and visuospatial group factors are derived from factor scores for these three abilities. The primary abilities, however, are calculated directly from individual tests. Fifthly, some of the values for the WISC-R in Table 1 differ in detail from those given in Lynn and Hampson (1986c) because of the correction of small errors in the earlier publication.

We consider now the principal features of interest in the abilities of Japanese children displayed in Table 1.

1. The values for Spearman's g are set out in Column 1. They show that Japanese children score lower than American Caucasoids over the age range 2½-5½ years; between 6-8 years they score about the same; from 9 years upwards Japanese children score slightly higher. The Japanese superiority from the age of 9 years upward is not statistically significant for individual years, but it is significant for the 9-16 year age group considered as a whole because of the larger numbers when the years are aggregated. There is clearly a significant age trend in Japanese children such that from lower values of Spearman's g amongst the youngest groups aged 2½-5½, they first draw level with American children between the ages of 6-8 years, and finally overtake them from 9 years of age onward.

2. It will be noted that these age trends in Japanese abilities are also present for all the other abilities shown in Table 1. In every case there is a rising trend from low values among 2½-3 years old to higher values among older age groups. There are two possible interpretations for these rising trends. Firstly, they could be an effect of a superior environment acting on an inferior genotype. This would be a cumulative advantage effect, such as Caucasoid children display relative to Negroid children in the deep south of the United States, as shown by Jensen (1977).

The alternative reading of the data is that Japanese children are slow maturers. It is believed that this is the preferable explanation. There are extensive data showing generally slow maturation rates among young Japanese children derived from the Denver Developmental Screening Test. This test measures a variety of indices of motor and cognitive development from birth to 6 years and has been standardized in Japan with a substantial normative sample by Ueda (1978). The results show that Japanese infants and young children show significant later maturation on a number of measures, as compared with Caucasoid norms derived from the United States. The slower development of Japanese infants is apparent at 1-2 months in head lifting and continues in head turning to a voice, rolling over at 3-5 months and removing garments at 15-20 months. At 2-4 years Japanese late maturation appears in early cognitive tasks including copying a circle and size of vocabulary, and vocabulary remains significantly retarded in young Japanese children up to the age of 6 years. There is evidence from elsewhere to suggest that slow maturation is a general characteristic of Mongoloids. Thus late skeletal maturity is present among Chinese infants in Hong Kong and ethnic Japanese children in California (Eveleth and Tanner, 1976, p.200).

It is proposed therefore that the low means obtained by young Japanese children aged 2½-5 years on the McCarthy Scales are best interpreted as functions of the slower maturation of Mongoloids which is shown for motor and early cognitive development by the Denver Development

**Table 1** Mean IQs of Japanese children in relation to American Caucasoid means of 100 and standard deviations of 15. Source: Lynn and Hampson, 1986a, b and c

| | | | | Verbal primaries | | | | Visuospatial primaries | | Other primaries | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | Spearman's g | Verbal GF | Visuospatial GF | Comprehension | Fluency | Immediate memory | Number | Spatial | Drawing | Inductive reasoning | Musical rhythm | Perceptual speed | Test |
| 2½ | 94.4 | 92.8 | 97.0 | 91.8 | 92.4 | 89.8 | 94.6 | 92.8 | 99.0 | 102.6 | 99.1 | — | McCarthy |
| 3 | 94.1 | 92.5 | 96.5 | 90.4 | 91.5 | 92.4 | 91.9 | 95.1 | 99.4 | 98.5 | 94.6 | — | McCarthy |
| 3½ | 96.6 | 94.7 | 99.5 | 93.3 | 93.5 | 92.5 | 93.0 | 96.6 | 103.0 | 100.0 | 101.8 | — | McCarthy |
| 4 | 95.9 | 93.1 | 99.6 | 89.5 | 96.6 | 92.1 | 93.6 | 102.1 | 102.0 | 100.2 | 104.1 | — | McCarthy |
| 4½ | 97.1 | 93.8 | 101.6 | 89.5 | 98.8 | 92.5 | 94.3 | 104.4 | 105.3 | 99.6 | 100.7 | — | McCarthy |
| 5 | 97.2 | 92.6 | 103.7 | 86.4 | 97.6 | 87.9 | 93.0 | 101.5 | 112.8 | 100.5 | 103.9 | — | McCarthy |
| 5½ | 98.7 | 93.8 | 105.7 | 90.1 | 98.7 | 98.2 | 96.3 | 108.7 | 113.7 | 102.3 | 103.3 | — | McCarthy |
| 6½ | 101.2 | 97.1 | 107.2 | 97.3 | 102.6 | 93.7 | 97.3 | 106.5 | 119.4 | 100.8 | 105.3 | — | McCarthy |
| 7½ | 98.5 | 93.9 | 104.5 | 94.3 | 96.7 | 93.0 | 100.5 | 108.0 | 108.3 | 105.7 | 103.0 | — | McCarthy |
| 8 | 97.7 | 92.7 | 104.7 | 92.1 | 96.4 | 94.2 | 103.3 | 106.6 | 111.1 | 101.7 | 99.4 | — | McCarthy |
| 6 | 100.6 | 96.2 | 103.8 | 94.5 | — | — | 106.0 | 105.5 | — | — | — | — | WPPSI |
| 6 | 101.2 | 97.8 | 106.2 | 92.1 | — | 101.1 | 97.1 | 111.1 | — | — | — | 104.6 | WISC-R |
| 7 | 100.0 | 95.6 | 106.0 | 88.1 | — | 101.1 | 95.1 | 112.1 | — | — | — | 104.6 | WISC-R |
| 8 | 102.1 | 97.9 | 106.5 | 91.6 | — | 102.1 | 96.1 | 111.1 | — | — | — | 115.6 | WISC-R |
| 9 | 102.3 | 99.0 | 105.8 | 93.1 | — | 97.6 | 100.6 | 108.1 | — | — | — | 114.1 | WISC-R |
| 10 | 104.1 | 101.0 | 106.5 | 94.1 | — | 102.1 | 105.6 | 109.6 | — | — | — | 117.1 | WISC-R |
| 11 | 104.0 | 100.7 | 106.2 | 94.1 | — | 102.1 | 107.1 | 110.1 | — | — | — | 116.6 | WISC-R |
| 12 | 104.4 | 100.9 | 106.1 | 92.1 | — | 102.1 | 117.1 | 109.6 | — | — | — | 116.6 | WISC-R |
| 13 | 103.4 | 100.3 | 104.8 | 93.1 | — | 98.6 | 112.1 | 107.6 | — | — | — | 118.1 | WISC-R |
| 14 | 104.0 | 100.8 | 105.4 | 94.1 | — | 102.6 | 109.6 | 108.4 | — | — | — | 119.1 | WISC-R |
| 15 | 104.2 | 101.3 | 105.4 | 95.1 | — | 101.1 | 107.1 | 107.1 | — | — | — | 119.6 | WISC-R |
| 16 | 103.3 | 100.8 | 103.0 | 94.1 | — | 106.1 | 110.6 | 104.1 | — | — | — | 118.1 | WISC-R |

5% significance levels: deviations of 5.1 from 100 on the McCarthy Scales, 2.6 from 100 on the WPPSI, and 3.6 from 100 on the WISC-R.

Screening Test and is a general characteristic of Mongoloid infants and young children.

3. Looking now at the Japanese IQs for the verbal and visuospatial group factors, we see that at all ages the Japanese are stronger on the visuospatial than on the verbal abilities. The difference is about 4-6 IQ points among 2½-4 year olds, widens to about 10 IQ points among 5-8 year olds, and then narrows again to around 5-6 IQ points. Because of the slow maturation of Japanese children, to adopt the hypothesis proposed above, very young Japanese children tend to be inferior to American Caucasoids on both these abilities. But by age 5½ they are superior to the Caucasoids on the visuospatial abilities at a statistically significant level, while remaining inferior on the verbal abilities. This curious and striking pattern is retained throughout the rest of the age range.

4. The four verbal primaries — comprehension, fluency, immediate verbal memory and number — consistently reproduce the low scores on the group verbal factor between the ages of 2½-6½ years. Thereafter, verbal comprehension remains weak, but both immediate verbal memory and number ability improve considerably. It is proposed that these improvements in immediate verbal memory and number ability should be attributed to the exceptional effectiveness of Japanese schools in teaching arithmetic. Number ability is mental arithmetic, while immediate verbal memory is tested by memory for digits and it is suggested that the greater familiarity and practice with digits to which Japanese children are exposed in their schools is the explanation for their marked improvement in this primary during the school years. Several observers of Japanese schools have noted that their efficiency is of a totally different order from those in the United States and, for that matter, of Europe. The whole question of the efficiency of Japanese schools and the high educational standards of Japanese children has been reviewed in a separate publication (Lynn, 1987). Compulsory schooling in Japan begins at the age of 6 years, and it is from about this age that Japanese children show a strong increase in their number and memory span abilities.

The school effects on raising the number and immediate verbal memory primaries contribute to the increase in the strength of the Japanese verbal group factor from the age of about 9 years onwards. It is therefore proposed that the true value of Japanese verbal abilities, uncontaminated by school effects, is represented by the scores made by 6-8 year olds, i.e., around 97.

5. On the two visuospatial primaries — spatial ability and drawing — the very young Japanese children are weak. This is attributed to their slow maturation in the early years of childhood. From the age of 4 years upwards they are consistently strong on both these primaries. On spatial ability, treated here as a single primary following Cattell (1971), the superiority of Japanese children is about one half the standard deviation (7-8 IQ points) from the age of 5½ years upwards. The second visuospatial primary given in Table 1 is drawing ability. It has been shown by Noland and Sanders (1973) that this ability is much more highly correlated with the performance scale of the Wechsler Test (WISC) than with the verbal scale and it is on the basis of this and other evidence that it is placed with

the visuospatial abilities. It will be noted that the Japanese children are exceptionally strong on this primary.

6. The last three columns of Table 1 give Japanese values for three further primaries which do not clearly belong to either of the verbal or visuospatial group factors. Inductive reasoning is as close a measure as can be obtained of Spearman's g. Over the age range 2½-5 years Japanese children obtained about the same means as American Caucasoids, but from 5½-8 years they score a little higher and at the age of 7½ the Japanese superiority is statistically significant. The proposed explanation for this trend is that the values among the young age groups are depressed by the late maturation of Japanese children. The means for the 5½-8 year olds are the true values and confirm that the Japanese children are a little higher than American Caucasoids for Spearman's g.

The second primary ability in this group is musical rhythm. The means of the Japanese children are about the same as the American. The third primary is perceptual speed. The means of this ability are calculated from the WISC-R coding and are very substantially higher than the American means. Coding appears to be a visuospatial skill, but factor analyses of the WISC-R show that it does not load on the visuospatial factor. For this reason it is shown in Table 1 as an independent primary. Nevertheless, it is suggested that coding is in fact a visuospatial skill but one which places heavy demands on visuospatial memory in the fast comparison processes that are required by the task. Some data consistent with this interpretation are reported by Majeres (1983). It is suggested therefore that the very high scores obtained by Japanese children on this ability confirm our conclusion that the Japanese are strong on all visuospatial abilities.

7. Conclusions: It is proposed that among the considerable data set out in Table 2 the following four generalizations can be made on the abilities of Japanese children in relation to American Caucasoids. Firstly, they are slow maturers. This accounts for their low initial scores on all abilities followed by subsequent improvement. Secondly, Japanese children are marginally superior for Spearman's g. Thirdly, they are weak on the verbal abilities. Fourthly, they are quite strongly superior on the visuospatial abilities. In the next section we examine how far these generalizations are corroborated by other studies on the intelligence of the Japanese.

**Table 2** Results on the Matching Familiar Figures Test for Japanese, American and Israeli children. Source: Salkind, Kojima and Zelniker, 1978

| | Errors | | | | Time | | |
|---|---|---|---|---|---|---|---|
| Age | Japanese | American | Israeli | J-A Difference | Japanese | American | Israeli |
| 5 | 18.4 | 22.6 | 26.0 | 0.60 | 11.9 | 7.2 | 6.0 |
| 6 | 15.6 | 17.6 | 24.1 | 0.29 | 12.5 | 10.6 | 7.8 |
| 7 | 10.7 | 14.8 | 13.4 | 0.63 | 14.7 | 12.0 | 14.2 |
| 8 | 7.7 | 12.7 | 12.2 | 0.80 | 14.8 | 13.4 | 15.2 |
| 9 | 7.3 | 9.1 | 10.5 | 0.31 | 13.7 | 16.4 | 16.5 |
| 10 | 8.4 | 7.4 | 8.2 | -0.19 | 9.8 | 17.2 | 22.0 |

## 2. Further studies of Japanese intelligence

### 1. The Minneapolis-Sendai Study

This study compared Japanese 6 and 10 year olds from the city of Sendai with comparable Caucasoid American children from Minneapolis. One part of the study consisted of the results of ten cognitive tests (Stevenson, Stigler, Lee, Lucker, Kitamura and Hsu, 1985). These tests fell into three groups. Firstly: five verbal tests of vocabulary, information, verbal memory for stories, words and numbers. Of the ten comparisons derived from these five tests for the two age groups, the American children performed better in all ten cases, of which eight were statistically significant. Secondly: a test of spatial relations adapted from Thurstone's Primary Mental Abilities. On this Japanese children of both ages performed significantly better. Thirdly: a test designated verbal-spatial representation and requiring both verbal and spatial abilities, on which there were no differences between Japanese and American children. Fourthly: a perceptual speed test involving matching a drawing to one of a set, i.e. a version of the Matching Familiar Figures Test (see below). On this Japanese 6 year olds scored significantly higher than American, but at the 10 year old level the difference was not significant. The last test should probably be considered as a further measure of visuospatial abilities.

In a further part of the study, educational achievement tests of arithmetic, reading vocabulary and reading comprehension were administered to the 10 year olds (Stigler, Lee, Lucker and Stevenson, 1982). It was found that the Japanese children were well ahead of the American children on arithmetic. The authors rightly conclude that this is largely due to the superior teaching efficiency of Japanese schools. This result is consistent with the Japanese superiority on number ability derived from the arithmetic scale of the WISC-R (see Table 1). On the two reading tests the Japanese scores were below those of the American, although only in the case of reading vocabulary was the difference statistically significant. Our interpretation of this result is that it is a reflection of the underlying weakness of Japanese verbal abilities.

The interest of this study is that it provides data on Japanese and American strengths and weaknesses using carefully matched samples for a wide range of abilities, and especially for the verbal abilities, which are difficult to obtain. It is clear that the results give strong support to the generalization that the Japanese are weaker than American Caucasoids on the verbal abilities and stronger on the visuospatial abilities.

### 2. The Differential Aptitude Test

This American test provides measures of the major primary abilities. Summarized here is a study comparing American, Japanese and British 13-15 year olds on the abstract reasoning and space relations scales, reported in greater detail in Lynn, Hampson and Iwawaki (1987). The abstract reasoning scale consists of series problems in the form of geometric designs, similar to those in the Progressive Matrices, and should be regarded as a pure Spearman's g test. The space relations scale consists of problems involving the transposition of two dimensional designs into three dimensional shapes. It requires visualization; males do better on this test than females, and it is undoubtedly a test of the spatial primary or, more narrowly, visualization.

The test was standardized in the United States in 1972 and Britain in 1978. When the means are "race and time" adjusted, the British means are 99.4 on abstract reasoning and 101.0 on space relations. The interest of this result is that it shows the virtual identity of the means of the two Caucasoid populations drawn from the United States and Britain, and therefore suggests that American Caucasoids adequately represent Caucasoids from the rest of the economically advanced world.

The two scales were administered to a sample of 178 Japanese adolescents in 1985. The "race and time" adjusted means were 104.5 for abstract reasoning and 114.0 for space relations, both of which are significantly higher than the American and British means. The result confirms the generalization that the Japanese are marginally superior to Caucasoids on Spearman's g, represented by the abstract reasoning test, and substantially higher on the spatial primary.

## 3. The Columbia Mental Maturity Scale

This is an American test first published in 1954 and revised and restandardized in 1972 (Burgemeister, Blum and Large, 1972). It covers the age range 3.6-9.6 years. The norms of the 1972 tests were obtained from a representative sample stratified by sex, racial group, geographical region and parental occupation. The CMMS consists of a series of five pictures of objects or geometric shapes and the child has to find the common concept to which four of the pictures belong and identify the discrepant item. In some of the later items the pictures are conceptually linked in two pairs, again leaving one remaining picture to be identified. It is described by the authors as a test of general reasoning ability. This is correct and, in terms of the hierarchical model of intelligence, it is a pure test of Spearman's g. This is evident firstly from the nature of the test and secondly from a study in which the test was administered to a sample of children together with the Primary Mental Abilities Test. The correlations between the CMMA and the PMA scales were: Reasoning, 0.61; Verbal Comprehension, 0.51; Spatial, 0.31; Perception, 0.48; Number, 0.41 (Miller and Turner, 1955). This result shows that the test is principally a measure of general reasoning and is not strongly biased towards either the verbal or the visuospatial abilities.

The test was standardized in Japan in 1982 on an apparently well drawn sample stratified for sex, geographical region and urban-rural location. The mean IQ of the Japanese sample, in relation to an American mean of 100, was 113. This figure requires race and time adjustment downwards. This entails the subtraction from the Japanese mean of 1.7 IQ points for a comparison with American Caucasoid children only, and a further 3.0 IQ points for the 10 years separating the two standardizations. In addition, the CMMS has a standard deviation of 16, whereas we are working throughout on a standard deviation of 15. This adjustment requires a further reduction of the Japanese IQ of 0.8.

The three adjustments together require the subtraction of 5.5 IQ points from the Japanese mean, giving a final figure of 107.5. This figure is somewhat higher than the estimates of Japanese values for Spearman's g derived from the McCarthy Scales, the WPPSI and WISC-R.

## 4. The Matching Familiar Figures Test

This test (the MFFT) consists of the presentation of a drawing of a common object (e.g. a boat, pair of scissors, hen) together with four, six or eight other drawings of which one is identical and the others are almost identical to the standard drawing. There are twelve of these problems. The test was originally constructed in the United States by Kagan, Rosman, Day, Albert and Phillips (1964) and was intended to measure a cognitive style trait designated reflection-impulsivity. The theory was that some individuals are reflective, i.e. cautious, slow and accurate, whereas others are impulsive, i.e. rash, fast and inaccurate. The test is scored for both accuracy and speed and it is therefore possible to characterize individuals as slow-accurates (reflectives) or fast-inaccurates (impulsives).

There is no doubt that the MFFT is to some degree a measure of intelligence. A comprehensive review by Messer (1976) lists 23 studies in which the MFFT was administered together with an intelligence test. All the studies found positive correlations averaging around 0.30 between intelligence and accuracy, but speed as such has only low positive correlations with intelligence. MFFT scores correlate more highly with visuospatial than with verbal abilities. Thus MFFT scores for both accuracy and speed correlated more highly with the non-verbal section of the Otis-Lennon Mental Abilities Test than with the verbal section (Eska and Black, 1971). Similarly, Plomin and Buss (1973) reported that MFFT accuracy correlated 0.38 with the performance scale of the WISC but only 0.05 with the verbal scale.

It is suggested that the MFFT measures the following cognitive abilities in addition to the cognitive style for which the test was originally designed. Firstly, it is proposed by Jensen (1980, p. 618) that it is a reasonably good measure of Spearman's g. This is because the individual with high g takes a reflexive approach to problems and strives primarily for accuracy. Secondly, the test is largely a measure of the visuospatial abilities. At the primary ability level, the MFFT appears to be measuring the visual memory primary of Ekstrom, French and Harman (1976). The test requires the memorization of all the features of the pictures and then a comparison of all the facsimiles with the standard to identify the perfect match. To achieve accuracy and speed on the test therefore requires accurate visual memory.

In view of the strong visuospatial abilities of Japanese children, it would be expected that they would do well on the MFFT. Extensive data on this question have been published by Salkind, Kojima and Zelniker (1978). The samples consisted of 2,255 American children and 760 Japanese children in the age range of 5-10 years. In addition there were approximately 1,500 Israeli children. The samples were selected to be representative of middle class children of normal intelligence in the three countries. The most interesting measure to be derived from the test is accuracy because this is the primary correlate of intelligence. The results for children of the three nationalities are shown in Table 2. The data are given as the mean number of errors for each of the six age groups. It will be seen that the Japanese 5-9 year olds make fewer errors and are therefore more accurate than either the American or the Israeli children. All these differences are statistically significant. However, among the 10 year olds the relationship between the nationalities is reversed. The reason for this is that at this age the Japanese work considerably faster than either the American or Israeli children.

The differences in error scores between the Japanese and American children have been calculated as proportions of the American standard deviations and are shown in that form in column 4 of Table 2. The mean of these six figures is 0.50, indicating that the total Japanese sample achieved a higher score than the American sample by one half of an American standard deviation, corresponding to 7.5 IQ points. This figure is close to the Japanese superiority on the visuospatial abilities shown previously in Table 1.

The MFFT is also scored for the time taken by the child to complete the test. These times for the six age groups are shown for the three nationalities in columns 5, 6 and 7 of Table 2. It will be seen that the younger Japanese children (the 5-8 year olds) are slower than the American but the older Japanese children (the 9-10 year olds) are faster. These time figures provide the explanation for the slightly higher error scores made by Japanese 10 year olds in contrast to the lower error scores of the Japanese 5-9 year olds. It is apparent that Japanese 10 year olds are much faster than American 10 year olds and that they achieve closely similar error scores in about half the time. It is evident therefore that the Japanese 10 year olds achieve better results if these are considered in terms of the number of correct responses per unit time.

When the error and time scores of the three nationalities are considered together, it is clear that Japanese 5-8 year olds adopt the strategy of an accurate and relatively slow approach to the problems, while the American and Israeli children are inaccurate but fast. Japanese children are therefore reflectives and American and Israeli children are impulsives. The 9 year old Japanese children are both faster and more accurate than American and Israeli children. The Japanese 10 year olds are faster still but at this age they are trading accuracy for speed and are making slightly more errors. Salkind, Kojima and Zelniker (1978) suggest that these trends indicate that there is what they call a "developmental shift" in all three cultures, such that young children tend to be impulsives with a fast-inaccurate performance and that as they grow older they become more reflexive. In this development, as these authors point out, Japanese children are about two years ahead of American and Israeli children. The authors suggest that socialization pressures in the Japanese family are probably responsible for the earlier acquisition of a reflexive strategy among Japanese children but they offer no evidence for this speculation. The results can be explained economically in terms of Japanese superiority for Spearman's g and the visuospatial abilities and clearly corroborate the data set out in Table 1.

## 5. The Wechsler Intelligence Scale for Children

This test was constructed and standardized in the United States in 1948 and in Japan in 1951. The performance subtests were retained almost entirely unaltered in the Japanese standardization, but the verbal subtests underwent considerable alteration with the exception of Digit Span. The Japanese means on the subtests for which a comparison can be made with the American means have been calculated and published by the writer (Lynn, 1977a). On the performance scale the Japanese children obtained a mean IQ of 103.1. This can be considered a measure of visuospatial abilities. The figures need to be reduced by 0.9 percent to 102.2 because of the three-year time lag between the two standardizations, but no further reduction entailing the removal of American Negroids is necessary because this test was standardized in the United States on Caucasoids only. The Japanese superiority of 2.2 IQ points is statistically significant and therefore confirms the later results showing high Japanese visuospatial abilities.

As noted, the only verbal test for which a Japanese-American comparison could be made was Digit Span. The mean Japanese IQ computed for this single subtest is 90, which needs to be reduced to 89.1 because of the three-year time lag between the two standardizations. Thus the WISC results from 1952 show the same Japanese pattern of low verbal-high visuospatial ability. Both abilities are somewhat lower than they were in the 1970s as shown in Table 1. The explanation for this is that all Japanese abilities have been increasing faster than American over the last three decades, as we have shown in detail in Lynn (1982) and Lynn and Hampson (1986d).

## 6. The Wechsler Adult Intelligence Scale

This test was standardized in the United States in 1954 and in Japan in 1956. Unfortunately the test was considerably changed in the Japanese standardization and only three subtests were retained unaltered, namely Digit Span, Digit Symbol and Block Design. Japanese IQs computed from these three tests are 100.0, 105.4 and 106.0 (Lynn, 1977a). These three figures require race and time adjustment downwards by 1.7 IQ points for race and 0.6 IQ points for the two-year time lag between the two standardizations, making a total of 2.3 IQ points. This gives a figure of 97.7 for Digit Span showing a relatively weak score on this test of immediate verbal memory which was apparent in the WISC-R and also the WISC. The adjusted Digit Symbol and Block Design IQs are 103.1 and 103.7. The Digit Symbol test in the WAIS is a measure of the visuospatial abilities. This is clearly apparent from factor analyses of the entire test which show that Digit Symbol belongs to the visuospatial group (Berger, Bernstein, Klein, Cohen and Lucas, 1964). Block Design is, of course, also a visuospatial test and the results on these two tests evidently confirm the Japanese strength on these abilities.

## 7. The Goodenough-Harris Drawing Test

It was shown early in the century by Burt and Goodenough that tests of drawing ability are positively related to general intelligence and these conclusions have been confirmed by numerous investigators (Jensen, 1980). In the Goodenough-Harris test the child is asked to draw a picture of a man, a woman and self. These drawings are scored according to stipulated criteria and the scores transformed into IQs on the basis of extensive normative data collected in the United States (Harris, 1963). The test appears to be primarily a test of the visuospatial abilities, especially insofar as it is scored from the correctness of proportions (MacFarlane and Smith, 1964).

The test was administered by Hilger, Klett and Watson (1976) to an apparently representative sample of 30 Japanese 6 year olds in a village school in the Japanese island of Hokkaido. The mean IQ of these Japanese children, in terms of an American mean of 100, was 138. This remarkable figure will possibly strain the credence of some readers, but it should nevertheless be noted that Japanese 6½ year olds achieved a mean IQ of 119.4 on the drawing test in the McCarthy Scales, as shown in Table 1, and there is little doubt that Japanese children are strong on this primary component of the visuospatial abilities.

## 8. The Embedded Figures Test

This test (the EFT) was first constructed by Gottschaldt and consists of the identification of a simple figure embedded in a complex one. In nature this ability is used to perceive a well-camouflaged animal against a background and is useful for the detection of both prey and predators who are frequently so camouflaged. This ability was considered by Thurstone (1944) to be a measure of the primary ability he designated Flexibility of Closure and this has been accepted by Cattell (1971) and Ekstrom, French and Harman (1976). On the basis of correlational and factorial studies, Smith (1964) and Pawlik (1966) consider that this primary is one of the visuospatial abilities and there is little doubt that they are correct. Thus, to note a subsequent study, Bergman and Engelbrekson (1973) found that among Swedish university students the Embedded Figures Test was correlated about twice as highly with tests of spatial ability as with vocabulary. Boys tend to do better on this than girls and this is a well known marker for a test of the visuospatial abilities.

A comparison between Japanese, American and British 9-10 year olds on the Embedded Figures Test has been made by Bagley, Iwawaki and Young (1983). They report means for six samples of Japanese children, four samples of American children and four samples of British children. All six

Japanese means were higher than all of the eight American and British means and the Japanese superiority is undoubtedly statistically significant. Simple averaging of the means of all the samples gives the Japanese children a grand mean approximately 0.9 of a standard deviation higher than that of the combined American and British children, equivalent to an IQ of 113.5. The interest of this result is that it shows the superiority of Japanese children on one of the visuospatial primaries for which evidence has hitherto been unavailable and at the same time confirms the strength of Japanese children on this group of abilities.

## 9. The Kyoto NX Test

This is a Japanese intelligence test constructed and standardized by psychologists at the University of Kyoto. It consists of 12 scales measuring reasoning, verbal comprehension, numerical and visuospatial abilities. The test has been administered to children in the United Kingdom, thereby introducing a change to the usual procedures in which American tests have been first constructed and standardized in the United States and subsequently standardized in Japan (Lynn and Dziobon, 1980). Five of the verbal tests were considered to be untranslatable because of Japanese language characteristics for which equivalents could not be found in English.

The remaining seven tests were measures of non-verbal reasoning, numerical and visuospatial abilities and should probably be considered collectively as largely a measure of Spearman's g. This reduced form of the test was administered in 1978 to a sample of 212 British 9-10 year olds. Also administered to the sample was the American Primary Mental Abilities Test to make it possible to calibrate the Kyoto Test against a well normed American test. The results indicated a Japanese mean IQ of 110.3 as the equivalent of the American mean of 100. The Japanese mean requires race and time adjustment downwards by 1.7 and 3.0 IQ points (the PMA and the Kyoto test were standardized in 1962 and 1972 respectively), giving a Japanese IQ of 105.6.

## 10. The Kyoto New NX Test

This is a Japanese group test consisting of 12 subtests measuring verbal, numerical and visuospatial abilities, constructed and standardized in Japan in 1968. There are three versions of the test designed for different age groups. We have administered the 9-15 year old version to 216 13-14 year olds in Northern Ireland. The results of this study are reported in detail in Lynn, Hampson and Bingham (1987).

The tests can be described as follows. The verbal subtests consist of jumbled sentences, verbal comprehension and memory for a story; the numerical tests consist of addition and subtraction problems; the visuospatial tests consist of paper folding and other visualization problems.

In addition to the Kyoto Test, the subjects also took the Standard

Progressive Matrices. The purpose of this was to make it possible to calibrate the Kyoto Test against a well standardized British test and so calculate Japanese IQs in relation to a British mean of 100. The sample obtained a mean IQ of 99.2 on the SPM, indicating that it was as representative of British children as could be expected. On the Kyoto Test the mean IQs of the British children, after adjustment for the time interval between the two standardizations, were 102.9 for verbal ability , 103.3 for number ability, and 106.7 for visuospatial ability. The results for the verbal and visuospatial abilities are reasonably close, although slightly higher, to those given for this age group in Table 1 (100.8 and 105.4 respectively) and confirm the relative strength of the Japanese on the visuospatial abilities in relation to their verbal abilities. The Japanese numerical abilities, however, appear rather weaker in this study than those given in Table 1 derived from the WISC-R (103.3 as against 110.5). The reason for this is that the comparison in this study is between Japanese and British children whereas the WISC-R data are a comparison between Japanese and American children. Numerical ability is to some degree determined by the efficiency with which arithmetic is taught in schools and British schools are more effective in this regard than American. A review of the evidence on this question is given in Lynn (1987).

Although the Kyoto Test does not contain non-verbal reasoning problems of the kind which provide the best single measure of Spearman's g, an approximate measure of Spearman's g can be obtained by averaging the means for the verbal and visuospatial tests. The resulting figure is 104.8 and is closely similar to the mean of 104.0 for 14 year olds given in Table 1.

## 11. The Denver Developmental Screening Test

This test has been described already in connection with the problem of the tendency of young Japanese children in the 2-5 year age range to be retarded on all cognitive abilities. The test contains vocabulary items and on these Japanese children score substantially lower than American children up to the age of 6 years, the last year covered by the test. This result is therefore consistent with the generalization that Japanese children are weak on the verbal abilities, but it is not certain to what degree their weakness on this test is attributable to a general maturational lag affecting all cognitive abilities.

## 12. Conclusions

This section has presented summaries of eleven studies of Japanese intelligence in order to examine how far they corroborate the results derived from the McCarthy Scales, the WPPSI and WISC-R set out in Table 1. We have seen that five studies confirm that Japanese children are superior to American and British Caucasoids in regard to Spearman's g. These are the studies employing the DAT, the CMMS, the MFFT, the Kyoto NX Test and the Kyoto New NX Test. The four of these studies for which a figure for Spearman's g can be calculated all yield higher values than those obtained from the WISC-R (the values derived from the McCarthy and the WPPSI being set aside as too low by virtue of the slow maturation of the Mongoloids). The values obtained from these four tests are 104.5 (the DAT), 107.5 (the CMMS), 105.6 (The Kyoto NX) and 106.2 (the Kyoto New NX). These are all higher than the values for Spearman's g derived from the WISC-R, which range between 98.8 and 103.1 and average 101.7. These discrepancies can be ascribed to two factors. Firstly, different methods have been employed for the calculation of Spearman's g. In the case of the WISC-R, Spearman's g was calculated from the factor loadings on the first principal component. This method gives a verbal bias to the values for Spearman's g because the verbal tests have higher loadings on the first principal component than the visuospatial tests. Since the Japanese tend to be weak on the verbal abilities, this verbal bias reduces their scores for Spearman's g. The DAT and the CMMS are abstract reasoning tests and can be considered as pure measures of Spearman's g, while the two Kyoto tests contain a mix of various verbal and visuospatial tests which have been averaged to yield a measure of Spearman's g. It will be evident that the precise Japanese value of Spearman's g will vary within limits according to how it is measured. Nevertheless, the five studies reviewed in this section and the WISC-R results all show that Japanese values for Spearman's g are higher than those of Caucasoids in the United States and Great Britain.

Eight studies reviewed in this section show that Japanese children are particularly strong on the visuospatial abilities. These are the Minneapolis-Sendai investigation and the studies employing the DAT, the MFFT, the WISC, the WAIS, the Goodenough-Harris Drawing Test, the EFT and the Kyoto New NX Test. Five studies confirm that the Japanese are either absolutely or relatively weak on the verbal abilities. These are the Minneapolis-Sendai investigation, the WISC, the WAIS, the Kyoto New NX Test and the Denver Developmental Screening Test. Thus, the eleven studies reviewed in this section establish on a reasonably secure footing the conclusions proposed in the preceding section, namely that the Japanese are characterized by high Spearman's g, strong visuospatial abilities and relatively weak verbal abilities. We turn next to a consideration of whether this pattern of abilities also holds for Mongoloids in the United States.

## 3. The intelligence of Mongoloids in the United States

The accumulated evidence on the intelligence of Mongoloids in the United States has been reviewed relatively recently by Vernon (1982) and it is unnecessary to do more than give a brief summary of his conclusions and update his review. On the basis of the data as a whole, Vernon observes that the earlier studies showed quite considerable weakness in the verbal abilities which should be attributed to difficulties with the English language among recent immigrants, but that some degree of this weakness is still present among thoroughly acculturated American Mongoloids. He concludes that the more recent studies "indicate mean IQs on verbal group tests of about 97 (i.e., a little below the white average) and 110 on non-verbal and spatial tests (much above average)" (Vernon, 1982, p.28). The non-verbal IQs are based on tests of abstract reasoning such as the Progressive Matrices and should be considered as pure Spearman's g tests. One of the largest of the studies leading to this conclusion is Flaugher and Rock's (1972) investigation of some 18,000 high school juniors in Los Angeles, where the ethnic Orientals obtained higher means than the Caucasoids on reasoning and spatial tests but lower on verbal tests. They also did better on mathematics, which among this age group depends largely on Spearman's g. Undoubtedly the most compelling, by virtue of the vast size of the sample, of the American investigations on the intelligence of Mongoloids is the Coleman, Campbell, Hobson, McPartland, Hood, Weinfield and York (1966) study of some 650,000 children drawn from all over the United States. If the mean IQ of American Caucasoids is set at 100 (SD:15), then the mean non-verbal IQ assessed by tests of abstract reasoning, a pure test of Spearman's g, of 6 year old American Mongoloids was 103.75 and their verbal intelligence 97.60. In Table 1 three readings for Japanese 6 year olds have been given, of which the averages are 101.0 for Spearman's g and 97.0 for verbal ability. Considering that different tests were used in these two inquiries it is impossible not to be struck by the close similarity between the ability patterns of these two samples of Mongoloids in such widely different geographical locations.

Furthermore, it should be noted that many of the American studies on the intelligence of Mongoloids have been carried out on samples consisting largely or even entirely of ethnic Chinese. The appearance of the typical Mongoloid ability pattern in these samples suggests that it is not confined to the Japanese but is a universal pattern among Mongoloid peoples.

Since the appearance of Vernon's review, several papers have been published on the Hawaii Family Study of Cognition. In this study a number of intelligence tests have been administered to approximately 6,500 parents and children in Hawaii and within this sample approximately one-third are Caucasoids and one-third Mongoloids of Japanese origins, while the remaining third are native Hawaiians and various minorities such as Chinese. The means of the different ethnic groups on the tests have not been published but it is nevertheless apparent from the published results that the Caucasoids scored significantly higher on the verbal tests than on the spatial and that the reverse pattern was present in the Mongoloids (Nagoshi and Johnson, 1985).

Another study of the abilities of the American Mongoloids published since Vernon's review is that of Wing (1980). She reports the results of some 1,400 young adult applicants for the civil service in a large Western city. As part of the selection procedure the applicants were required to take five tests of the following abilities: verbal, judgment (verbal comprehension), induction, deduction and number. The applicants were then divided by race into Blacks, Mexican American, Filipino, Asian and White. The Asian group displayed once again the low verbal-high reasoning ability profile characteristic of Mongoloid populations.

## 4. The intelligence of Mongoloids in Southeast Asia

There are three countries in Southeast Asia for which there is evidence on Mongoloid intelligence, namely Hong Kong, Singapore and Taiwan. In Hong Kong a sample of 4,500 Chinese 13 year olds were given the Progressive Matrices, a pure test of Spearman's g, in a study by Can (1976). The mean IQ in relation to the British norms was approximately 120. However, the British norms date from 1938 and Chan's investigation was carried out in the mid 1970s and so the Hong Kong mean requires adjustment downwards. It has been shown that the mean IQ derived from the Progressive Matrices in Britain has been increasing by 1.86 IQ points per decade (Lynn and Hampson, 1986d). The appropriate downwards adjustment is therefore 6.70 IQ points, giving a mean IQ for Hong Kong Chinese of 113.3. This is clearly a high figure for a test of Spearman's g.

In Singapore a representative sample of Chinese 13 year olds was administered the Progressive Matrices in the mid-1970s in a study of which an account is given in Lynn (1977b). The mean IQ was approximately 110.0. This figure requires the same adjustment downwards as the Hong Kong figure given above, i.e., by 6.7 IQ points, giving a mean IQ of 103.3.

In Taiwan a sample of approximately 1,290 16 year olds was tested by Rodd (1959), using Cattell's Culture Fair Test, a pure test of Spearman's g. The sample was divided into indigenous Taiwanese and immigrants from mainland China, and the mean IQs of the two groups were 104 and 106 respectively. These means require time adjustment downwards by approximately 3.0 IQ points, giving means of 101 and 103.

It will be evident from this summary that Mongoloids in Hong Kong, Singapore and Taiwan tend to achieve the high values of Spearman's g which are characteristic of those in Japan and the United States. So far as is known, there is no evidence currently available on the relative strength of the verbal and visuospatial abilities in these people. This is a question that must await future investigation.

## 5. Conclusions

This review of the abilities of Mongoloids began with the presentation of a synthesis of three studies of the intelligence of the Japanese, derived from the McCarthy Scales, the WPPSI and the WISC-R. It was seen that the Japanese differ from American Caucasoids in four respects, namely that they have higher Spearman's g, low verbal ability (from the ages of $2^{1}/_{2}$-9 years but not thereafter), high visuospatial ability, and a developmental trend in which all abilities increase in strength over the years of early childhood. It is then seen that these features of Japanese abilities are confirmed by a number of other studies. It is shown next that these characteristics are also present among Mongoloids in the United States and, so far as the evidence goes, in the three Far East nations of Hong Kong, Singapore and Taiwan. It appears, therefore, that this distinctive ability profile is characteristic of the Mongoloids in a variety of geographical locations. This raises the question of the factors responsible for this pattern of abilities among Mongoloids, and it is to this problem that we turn now.

## II. ENVIRONMENTAL THEORY OF CAUCASOID-MONGOLOID INTELLIGENCE

In this part we discuss environmental explanations of the four features of intelligence distinguishing Caucasoids from Mongoloids.

### 1. Spearman's g

Environmental theorists have sought to explain group differences in Spearman's g, such as have often been found between social classes and also between Caucasoids and Negroids, largely in terms of differences in socio-economic status, incomes and family environment (see e.g., Flynn, 1980; Scarr and Carter-Saltzman, 1982). It is immediately clear that this line of explanation cannot be employed to explain the high Spearman's g of Mongoloids. None of the Mongoloid peoples for whom data on intelligence has been assembled in the first part of this paper enjoys higher incomes or socio-economic status than Caucasoids. In the United States most of the Mongoloids were initially laborers recruited to build railways and perform other unskilled work in the West and at this stage were well below Caucasoids in incomes and socio-economic status. Over the decades they have improved their position and by the second half of the present century are approximately the equals of the Caucasoids in these regards (Vernon, 1982). So far as Mongoloids in the countries of the Far East are concerned, their per capita incomes have been well below those of the United States and Britain for the whole of the present century. Per capita incomes for 1960, 1965 and 1970, taken as representative years of the period in which many of the samples for whom IQs have been presented were young children, are shown for the respective countries in Table 3. It will be seen that the per capita incomes in the four Mongoloid countries were consistently well below those of the United States and Britain. These data clearly refute the proposition advanced by many environmentalists to the effect that lower per capita income causes low IQ. Nevertheless, environmentalists are probably correct in their supposition that income has some positive effect on intelligence, or, more strictly, serves as a proxy for

**Table 3** Per capita national incomes in U.S. dollars in 1960, 1965 and 1970 (Source: United Nations Statistical Yearbooks)

| Country | 1960 | 1965 | 1970 |
|---|---|---|---|
| Japan | 421 | 694 | 1600 |
| Hong Kong | 333 | — | 735 |
| Singapore | 417 | 508 | 921 |
| Taiwan | 100 | 185 | — |
| Britain | 1277 | 1467 | 2606 |
| United States | 2500 | 2910 | 4270 |

the quality of environment which has this beneficial effect. It follows that the values for Mongoloid abilities given for the four Far East nations should probably be regarded as under-estimates of the values that would be obtained where Mongoloids and Caucasoids are reared in more closely matched environments. Since Mongoloids in these relatively unaffluent nations already obtain higher means for Spearman's g than Caucasoids in the United States and Britain, the inference that these means are under-estimates clearly provides a problem for environmental theory.

An alternative environmentalist theory might propose that Mongoloid parents provide a superior family environment for the cognitive development of their children. This theory encounters three difficulties. Firstly, direct comparisons of the cognitive socialization techniques of Japanese and American mothers have failed to show that Japanese mothers are in any way superior (Stevenson, Azuma and Hakuta, 1986). Secondly, it seems intrinsically implausible that hitherto undiscovered superior cognitive socialization techniques would be consistently present among Mongoloid parents in such disparate cultures as Japan, Singapore, Hong Kong, Taiwan and the United States. Thirdly, Japanese children are characterized by strikingly lower mean IQs over the age range 2½-5 followed by later superiority. An environmental explanation for this developmental curiosity would have to posit that Japanese parents are poor cognitive socializers of young children but efficient cognitive socializers of older children. It seems hardly credible that this could be the case. These are all difficult problems for environmental theorists.

## 2. Low verbal-high visuospatial abilities

These two abilities are taken together because the problem for environmental theory is to find some set of environmental variables which could act differently on the two abilities and raise the visuospatial abilities some 6-10 points higher than the verbal abilities. The data set out in Table 1 show that the mean IQ for Japanese verbal abilities over the age range 6-9 years is approximately 96, and from 10-16 years approximately 100. The mean IQ for Japanese visuospatial abilities is approximately 106 over the whole of the age range 6-16 years. The increase in the verbal abilities can probably be explained in environmental terms as an effect of Japanese education. It has been shown in detail that Japanese schools are far more efficient than those in the United States and Europe in the inculcation of scholastic skills (Lynn, 1987). These scholastic skills have considerable overlap with the verbal abilities, e.g. verbal comprehension and arithmetical ability, and play an important part in both sets of abilities. Thus the increase of these abilities over the years of schooling is best interpreted in environmentalist terms as a manifestation of the principle of cumulative advantage in a favorable environment.

If this is granted, the true Japanese IQs for the verbal and visuospatial abilities, uncontaminated by school effects on older children, are around 96 for verbal and 106 for visuospatial. The problem for environmental theory is therefore to find environmental variables which will depress the verbal abilities by around 4 IQ points and raise the visuospatial abilities by 6 IQ points. It is clear that it will not be easy to find environmental conditions that could have this effect.

This problem of differential values for different abilities in different populations is a familiar one which has long been known so far as Caucasoid-Negroid differences are concerned. It has frequently been found that Negroids in the United States are weak on Spearman's g, relatively strong on the verbal abilities and relatively weak on the visuospatial abilities. This pattern of Negroid abilities was shown by Shuey (1966) in an extensive review of the literature, by Coleman et al. (1966) so far as the selectively strong verbal abilities of Negroids is concerned, and by Jensen (1973b), Reynolds and Gutkin (1981) and Jensen and Reynolds (1982). It has been pointed out by Jensen (1973b) and again by Vernon (1979) that the existence of this pattern poses a problem for environmental theory because it is necessary to find a variable that depresses the several abilities differentially. The problem is particularly difficult because the pattern of abilities differentiating the races is not the same as the pattern differentiating the the socio-economic classes. It is well known that the ability that most differentiates the classes is verbal ability, whereas that which most differentiates the races is visuospatial ability (see Jensen and Reynolds, 1982, for the most sophisticated treatment of this issue). It is evident therefore that the environmental factors which differentially determine the pattern of abilities between the socio-economic classes cannot be operating to determine the differences between the races.

These phenomena pose difficult problems for environmental theory. Leading environmental theorists such as Flynn (1980) and Scarr and Carter-Saltzman (1982) have ignored these problems, and the inference to be drawn is probably that environmental theory cannot handle these data.

## 3. Developmental trends

The data set out in Table 1 show that Japanese children tend to show improvements in all abilities over the age range 2½-16 years. Young Japanese children aged 2½-3 years obtain significantly lower means for Spearman's g and the verbal abilities than American Caucasoids. These abilities gradually improve over the course of childhood, until by the age of 6 years Japanese children are significantly higher on the visuospatial abilities.

It has already been noted in our discussion of Spearman's g that the approach of environmental theory to these developmental trends would have to be to posit some environmental factors which act adversely on Japanese children age 2½-3, but which are replaced three or four years later by other environmental factors which act advantageously. It is obviously going to be very difficult to identify the environmental factors that could operate in this contradictory manner.

Probably the best strategy for the environmental theorist on this developmental problem would be to concede that Mongoloids are genetically programmed slow maturers up to the age of around 5 years. From this age onwards environmental theory would posit an advantageous family environment acting on all Mongoloid populations. An explanation along these lines would, of course, be the thin end of the wedge but is probably the best and the most promising position.

However, even this position presents a difficulty for the environmental theorist. An advantageous environment would be expected to act cumulatively over time, leading to gradually rising IQs over the years of childhood and adolescence. This phenomenon is known as cumulative advantage and its converse as cumulative deficit. Its existence has been demonstrated among Negroids in the deep South of the United States as compared with Caucasoids, i.e., these Negroids display progressively lower IQs with increasing age due to their disadvantageous environment (Jensen, 1977). The expected cumulative advantage does take place in Japanese children in the case of the verbal abilities. These increase from about 97 among 6 year olds to 101 among 16 year olds. This 4 IQ point increase should probably be attributed to the efficient teaching provided by Japanese schools. But there is no sign of any cumulative advantage effect for the visuospatial abilities. These remain constant at approximately 106 throughout the 6-16 age range. An environmentalist theory of the developmental trend of the visuospatial abilities of Japanese children would have to find a variable that raises the IQ from 100 among 4 year olds to 106 among 6 year olds, and thereafter has no further effect. Clearly it would be very difficult to discover an environmental variable which acts solely during these two critical years.

### 4. Conclusion

It is a well known phenomenon in science that as the evidence in a field accumulates it becomes progressively more difficult to construct a theory which will explain the totality of the data. I suggest that environmental theory is now confronted with this problem so far as Mongoloid-Caucasoid differences in intelligence are concerned. It has been argued that it is not possible to formulate plausible environmental explanations for any of the four principal features of Mongoloid intelligence, namely the high values for Spearman's g, the low verbal abilities, the strong visuospatial abilities, and the developmental trends. Taken together the problems posed by the totality of the data are probably insuperable for environmental theory. We therefore turn next to the question of whether a plausible explanation for the data can be provided by genetic theory.

## III. GENETIC THEORY OF MONGOLOID INTELLIGENCE

A genetic theory of Mongoloid intelligence would begin by positing that the various features of Caucasoid-Mongoloid differences in abilities and their developmental trends are genetically programmed characteristics differentiating the two races. Genetic theorists do not propose that genetic factors are the sole determinants of racial or other population differences in abilities (see e.g., Eysenck, 1984), but they do maintain that these are powerful determinants and that where populations are living in broadly comparable social and economic conditions the differences in their abilities are to a considerable extent a function of genetic differences. A genetic theory would explain the major features of the intelligence of Mongoloids as follows:

1. The consistency with which the same pattern of Mongoloid abilities is

found in different environments follows naturally from the assumption that there is a substantial element of genetic programming of these abilities. If Mongoloids are genetically programmed to display high values for Spearman's g from the age of 6 onwards, weak verbal abilities, strong visuospatial abilities and retarded development in infancy and early childhood, then these features will be found in all Mongoloid populations living in roughly comparable affluent societies. It has been seen that so far as the data go this prediction is confirmed for Mongoloids in such disparate environments as Japan, the United States, and the nations of the Far East.

The consistency with which the characteristics of Mongoloid abilities appear in diverse environments poses a major problem for environmental theory, since it requires that the same set of environmental factors is operating to produce the Mongoloid ability profile throughout these different environments. Genetic theory handles these consistencies well.

2. Genetic theory can provide an explanation for the developmental trends of the different abilities along the following lines. Firstly, Mongoloids are genetically programmed slow maturers in infancy and early childhood. This accounts for the low initial values and steady developmental increase of all abilities in Japanese children over the age range 2½-5 years and the delayed maturation of Mongoloid infants in Hong Kong and California. From the age of around 6 years Japanese children are exposed to a more efficient education system than those in the United States or elsewhere in the West, as shown in detail elsewhere (Lynn, 1987). The efficient Japanese education system acts only on the verbal abilities, especially numerical ability, which are taught in schools. Hence the verbal abilities all show increases over the 6-16 year age range. This is a straightforward case of cumulative advantage. The Japanese education system has no effect on the visuospatial abilities, which are not taught in schools. Hence the visuospatial abilities of Japanese children remain constant at approximately 106 throughout the 6-16 year age range. Japanese Spearman's g is broadly an average of the verbal and visuospatial abilities and hence shows a small rise throughout the years of childhood and adolescence.

3. Apart from educational effects, there is still the problem of the differential of approximately 10 IQ points between the verbal and visuospatial abilities of Mongoloids. This problem can be handled by genetic theory by the assumption that this happens to be the way Mongoloid abilities are genetically programmed. This explanation is all very well so far as it goes and it does have the merit of explaining the consistency of the Mongoloid profile in diverse environments, which is a problem for environmental theory. Nevertheless, to provide a satisfying explanation of this pattern of abilities the genetic theorist should offer an account in evolutionary terms for the origin of this ability profile. The unusual pattern of abilities of Mongoloids must have arisen through the operation of unique selection pressures operating on the Mongoloid peoples over a long period of time. At some point the genetic theorist is called upon to offer an account of these selection pressures and of how they brought about the observed Mongoloid ability profile. It is to the presentation of a theory of these selection pressures that we turn next.

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## IV. THE EVOLUTION OF MONGOLOID INTELLIGENCE

Here we present an evolutionary theory of the principal features of the intelligence of Mongoloids. We begin with an account of the general principles governing the evolution of intelligence; continue with accounts of the selection pressures responsible for the strong visuospatial abilities in males and strong verbal abilities in females; consider next the evolution of the Mongoloids' high Spearman's g and their strong visuospatial abilities; and finally offer an explanation of the weak verbal abilities of the Mongoloids.

### 1. The evolution of Spearman's g in the Hominids

For an understanding of the evolutionary processes responsible for the intelligence of Mongoloids it is necessary to understand the general principles underlying the evolution of intelligence, of which the present problem is a special case. These principles have been worked out by Jerison (1982). The most important of these principles, and the only one that need be called upon in this discussion, is that from time to time during the course of evolution a population moves into a new environmental niche in which survival demands greater intelligence. When this occurs the brain grows in size or efficiency in order to produce the greater intelligence that is required. The effect of the operation of this principle is that intelligence, and the brain size accommodating it, has evolved in jumps followed by long periods of equilibrium as populations have moved into new niches and then solved the problems of surviving in them.

One of the most important of these jumps took place approximately 220 million years ago. At this time the dominant species were large reptiles. Small reptiles found a new niche by becoming nocturnal. They rested quietly in burrows during the daytime, undetected by carnivorous large reptiles, and they came out at night when the large reptiles were asleep. This new niche was a good one, but it carried with it certain problems. For one thing it was cold at night, and so these small nocturnal reptiles evolved internally regulated temperature and became mammals. Another problem was that their visual sense was not a great deal of use to them, particularly on dark, moonless nights. To obtain adequate information about the world they came under selection pressure to develop their auditory, olfactory and tactile senses, which were not impaired in the hours of darkness, and to develop a larger brain in which information from all four senses could be integrated and analyzed. In response to this selection pressure they evolved a substantial increase in brain size to accommodate the new and more demanding information processing abilities.

Another of these jumps in intelligence took place approximately 5 million years ago among the apes living in East Africa. These apes were tree-living animals, like other primates, who had found an arboreal niche in which they could keep out of the way of predators and subsist on a diet of fruits, nuts, leaves and insects. This niche began to deteriorate some 12 million years ago. The climate in Africa became drier and the forests gradually disappeared and were replaced by grasslands. As a result, a number of these ape populations were forced onto these grasslands. They were poorly adapted for this new habitat and many of them perished.

Nevertheless, some managed to survive and for these the open grasslands acted as a challenging new niche. Survival in this new niche demanded greater intelligence, and in response to this selection pressure some of the apes developed a larger brain. They evolved into the species Australopithecus and they survived living in small groups by the shores of lakes and rivers and subsisting on a diet of grass seeds, fruits, nuts, shellfish, insects and tubers obtained by foraging (Isaac, 1978; Parker and Gibson, 1979).

The precarious new environment exerted continuous selection pressure for improved intelligence and in response to this pressure they evolved increases in all three of the major components of intelligence, i.e., general reasoning, verbal and visuospatial abilities. These increases in intelligence were developed from the rudimentary forms of all three abilities which must have been already possessed by the australopithecines since they are present in the extant apes. The ability of apes to reason was demonstrated by Kohler (1925) in his classical experiments with chimpanzees in which he showed that these animals can solve "insight problems" such as the comprehension of the relationships involved in slotting together two rods to form an extended hoe with which to pull bananas into a cage. In addition the extant apes possess a primitive form of verbal ability insofar as members of a group communicate with one another by sounds and gestures; and also of visuospatial ability which they employ in the use of tools such as twigs to extract ants and termites from their nests. All that was required for the australopithecines was to improve the abilities which they already possessed in primitive form.

The selective advantages of improved cognitive abilities were these. With better general reasoning they could plan for the future and solve a number of the great variety of problems involved in survival, group cooperation and maintaining a cohesive social structure. With improved verbal abilities they could communicate more effectively with one another in the planning and execution of group activities, in sharing knowledge which was useful for survival, and in passing knowledge down from parents to children. With improved visuospatial abilities they were able to make tools and weapons and to organize hunting expeditions. Under the impact of the continuing demands of this new niche, Australopithecus evolved into the successive hominid species of Homo erectus and Homo sapiens and the size of the brain grew approximately threefold.

## 2. Evolution of the verbal and visuospatial abilities in males and females

We now consider more closely the evolution of the verbal and visuospatial abilities and the way in which these became differentiated in males and females. Both these groups of abilities conferred selection advantages, the verbal abilities for communication and the visuospatial abilities for foraging and hunting. It is suggested by Lovejoy (1981) that these two abilities began to develop differentially in males and females quite early in hominid evolution. Males began to specialize in foraging and hunting, and for this purpose developed their visuospatial abilities, and females began to specialize in childrearing and education, and for this purpose developed their verbal abilities, including the teaching of language and the passing on of useful acquired knowledge from one generation to the next. These respective specializations were, of course, already present to some degree in other primates and indeed in many carnivorous mammals such as hunting dogs and wolves, and we can safely assume they were present in rudimentary form among the australopithecines.

We follow Lovejoy in his thesis that, so far as males were concerned, the initial form of this specialization was that they went out foraging for food. They developed the ability to construct simple tools for digging up edible tubers and for breaking open shellfish. These skills provided them with new food sources relatively inaccessible to competitors, as Parker and Gibson (1979) have pointed out. The cognitive basis for the development of these skills was good visuospatial abilities, with which they could visualize the food hidden under the ground, in the case of tubers, or within shells, in the case of shellfish. This development also provided the primary impetus for the development of bipedalism which was in many ways a disadvantageous adaptation because a bipedal animal cannot run as fast as a quadripedal. The compensatory adaptive advantages of bipedalism were that they freed the hands for making and using tools and for carrying food back to females and children. Initially the male australopithecines were not sufficiently skilled to hunt, but as they improved their intellectual abilities they were able to develop hunting skills. All three components of intelligence would have contributed to these hunting skills, but the visuospatial abilities would have been the most important. There were two principal ways in which improved visuospatial abilities facilitated the development of hunting. Firstly, they enabled the male australopithecines to throw rocks accurately at small animals and to stun, immobilize or kill them. Many small animals such as young baboons, rabbits and so forth sit still at a distance of some yards from a predator and do not run for cover until the predator approaches. It has been suggested by Calvin (1982) that male australopithecines exploited this propensity by developing accurate stone throwing skills by which they were able to kill such small prey from a distance. These accurate stone throwing skills depend upon good visuospatial abilities, to judge the distance, direction and velocity with which the missile has to be thrown. This dependence has been demonstrated by Kalakowski and Malina (1974) in a study in which they showed a positive correlation among adolescent boys between throwing accuracy and spatial ability measured by a standard intelligence test. Males are better at throwing stones than females and this superiority is present among 5-7 year olds (Jenkins, 1930). It is probable that Calvin is right in his suggestion that this male specialization was an australopithecine adaptation.

The second advantage of the visuospatial abilities for hunting was that they promoted the efficient organization of the group hunting expedition. The early hominids were social animals living in groups from which the adult and adolescent males went out on hunting trips in bands of a dozen or so. These hunting groups had sophisticated strategies such as driving their prey into bogs, the loops of rivers and so on (Passingham, 1982). For this they would have needed good visuospatial abilities to plan and execute strategies for surrounding their prey and driving them into natural traps where they could be caught.

At the same time that males developed strong visuospatial abilities to facilitate their specialization as hunters, females developed strong verbal abilities to improve their own specialization for the rearing of children. Good verbal abilities, especially those of verbal fluency and immediate memory, enabled mothers to teach language and useful knowledge, e.g., which foods are poisonous, what animals are dangerous and so forth. It is proposed that this division of labor between the sexes provides the explanation for the high visuospatial-low verbal pattern of abilities in males and the reverse pattern of abilities in females which has been virtually invariably found by intelligence testers among all contemporary races of Homo sapiens.

Nevertheless, to speak of a male and a female intelligence is an oversimplification. We follow Levy (1974) in supposing that there was overlap between the sexes and also individual differences within each sex in the relative strength of the verbal and visuospatial abilities. A continuum can be envisaged. At one extreme would be individuals with very high verbal abilities and very weak visuospatial abilities. They would have been predominantly but not exclusively female, and their special contributions to the wellbeing and survival of the group would have been their exceptional language abilities and their long term verbal memories. At the other extreme would be those with the converse pattern of very strong visuospatial abilities and weak verbal abilities. Their contribution would have been the solution of visuospatial problems involved in the construction of better tools, weapons, shelters and hunting strategies. They would have been predominantly male and they would have been taciturn animals — strong silent males — with relatively poor verbal fluency and memory. Most individuals of both sexes would not have been at either of these extremes. They would have been generalists, fairly good in both the verbal and visuospatial areas, females tending to have the high verbal-low visuospatial pattern and vice versa in males.

In short, the early hominids developed a balanced polymorphism in which several genotypes representing different mixes of the verbal and visuospatial abilities coexisted in different individuals because each genotype made its own contribution to the survival of the group. It will be noted that this thesis implies the existence of a negative association between the verbal and visuospatial abilities, such that the presence of high values of one is secured at the cost of low values for the other. This problem is taken up later in the paper.

## 3. Evolution of Spearman's g in Mongoloids

By approximately 250,000 years ago Australopithecus had evolved into Homo sapiens, and had acquired strong general intelligence and good verbal and visuospatial abilities. The next stage of the evolutionary process took place about 120,000 years ago.

By this time Homo sapiens was well adapted to survival in Africa and some groups began to migrate northwards into Europe and Asia. Those who remained in Africa were the ancestors of the living Negroids who retained the dark skin that gave protection from strong sunlight and the peppercorn hair that reduced the rapid evaporation of sweat and protected the head from excessive heat and from sunstroke. Those who migrated northwards evolved the pale skin which enabled them to absorb vitamin D from sunlight. At this stage these pale skinned populations were a single undifferentiated race (Nei, 1978).

A further stage of this evolution occurred approximately 60,000 years ago. From this time the ice ages began to descend on the northern regions and their effects were particularly severe in Northeast Asia. The reasons for this were firstly that this region is such a large land mass and secondly that the Himalayas acted as a barrier in the south. The effect was that the populations in Northeast Asia found themselves boxed in between the encroaching ice from the Himalayas in the south and from the Arctic region in the north. The cold to which they were subjected in this region was far more severe than that experienced by the other pale skinned populations in Europe, who were relatively close to the sea and had no southern ice barrier equivalent to the Himalayas. It was in response to this extreme cold that these populations evolved their distinctive physical adaptations of the epicanthic fold and the slit eyes to afford protection against the cold and the glare of the sunlight on the snow, and the flattened face and shortened limbs to reduce heat loss (Coon, 1955; Bodmer and Cavalli-Sforza, 1976). These physical adaptations to extreme cold differentiated the Mongoloid race from the Caucasoids in Europe and the Middle East.

It is suggested that this hostile environment acted as a new environmental niche which exerted selection pressure for a further increase in intelligence. As Jerison has observed, "it takes more brains to make a living in some niches than in others" (1982, p. 747) and if ever there was a niche where it took brains to survive it was surely Northeast Asia during the ice ages. This was the coldest part of the world inhabited by early Homo sapiens. Even today temperatures of -87 degrees F have been recorded in Siberia, and this would have been just an average day for the Mongoloid people during the ice ages. To survive in these temperatures they would have had to construct shelters well insulated from the cold, to build fires, to make warm clothes, to store food and to plan ahead for the winters which were even colder than the summers. For all of these the selection pressure for improved general intelligence would have been stronger than for the Caucasoids and the Negroids. It is therefore proposed that this is the most probable explanation in evolutionary terms for the high general intelligence (Spearman's g) of the Mongoloids.

## 4. Evolution of Mongoloid visuospatial abilities

The extreme cold of the ice ages would have generated a second selection pressure on the Mongoloids in addition to that for improved general intelligence, and this would have been for an increase of their visuospatial abilities. The reason for this is that the Mongoloids would have become heavily reliant on hunting for their food and the visuospatial abilities underlie good hunting skills.

Both early Homo sapiens and primitive peoples scattered throughout the world today are known as hunter-gatherers because they obtain their food partly by hunting and partly by gathering. But the proportions of hunting and gathering vary in different latitudes. In tropical and subtropical regions contemporary tribes subsist largely by gathering plant foods. These are available throughout the year and can be easily harvested, and so for people in these latitudes hunting for meat is not strictly necessary and forms only a minor part of their diet. Since this is the case for hunter-gatherer peoples in equatorial latitudes today, no doubt Lee (1968) and Passingham (1982) are correct in inferring that this has always been true of people in these regions.

However, when the first groups of Homo sapiens migrated northwards into Europe and Asia they found that there was no longer a ready supply of plant foods throughout the year. Plant foods became seasonal and during the winter and spring these peoples would have had to rely on meat foods. To obtain these they had to improve their hunting skills and hence they came under selection pressure for an increase in their visuospatial abilities. This pressure would have been strongest for the Mongoloids because it was they who occupied the coldest regions where plant foods were least available. We can reconstruct the life style of the three major races from that of contemporary hunter-gatherers studied by Lee (1968). Those in tropical and subtropical latitudes are mainly gatherers; those in temperate zones hunt and gather in approximately equal proportions; and those in the coldest latitudes live largely by hunting. The life style of the Mongoloids during the ice ages must have been similar to that of Eskimos who live very largely by hunting and fishing and have to do so because for much of the year no plant foods are available. The Eskimos, like the Mongoloids in Asia, have developed good visuospatial abilities (Berry, 1966; Vernon, 1979) and it is suggested that they have done so for the same reason.

To hunt effectively in the Arctic requires not only the visuospatial abilities of accurate stone throwing and the formulation of group hunting strategies. In addition, as Harris (1978) suggests, it requires the ability to isolate slight variations in visual stimulation from a relatively featureless array, such as the movement of a white Arctic hare against a background of snow and ice; to recall visual landmarks on long hunting expeditions away from home and to develop a good spatial map of an extensive terrain. All these requirements would have acted as selection pressures for the improvement of the visuospatial abilities and it is proposed that this is the explanation in evolutionary terms for the strong visuospatial abilities of living Mongoloids.

## 5. Evolution of Mongoloid verbal abilities

We now come to the puzzling question of the poor verbal abilities of Mongoloids. It has been argued that the inhospitable environment of the ice ages provided the selection pressure for the increase of general intelligence and of the visuospatial abilities of the Mongoloid peoples. It would appear to follow that this selection pressure would have acted also on the verbal abilities. These also would have conferred a selective advantage for survival, giving better communication skills, and therefore the verbal abilities should have also increased. Yet, as we have seen, the verbal abilities of Mongoloids are weaker than those of Caucasoids.

There are two ways of dealing with this problem. Firstly, it may be that the Caucasoid peoples were subjected to some other strong selection pressure for an increase of the verbal abilities which was not present to the same degree for the Mongoloid peoples. However, it is difficult to imagine what such a selection pressure could be. It is generally considered that verbal abilities, including the acquisition of language, developed because they facilitated group co-operation and the transmission of cultural knowledge from one generation to the next. The selection pressures for the development of the verbal abilities would surely have been at least as strong for the Mongoloid peoples in Northeast Asia as for the Caucasoid peoples in Europe and the Middle East. An explanation along these lines is therefore considered unpromising.

A second approach to the problem is that the enhancement of the visuospatial abilities in the Mongoloids took place at the expense of the verbal abilities. I believe that this is the correct explanation and that what evolved in the Mongoloids was a trade-off in which the verbal abilities were sacrificed to permit an increase in the visuospatial abilities. It has already been suggested that the first trade-off of this kind occurred much earlier in hominid evolution between the sexes, when males sacrificed their verbal abilities to permit an enhancement of their visuospatial abilities, and vice versa in females. The Mongoloids took this trade-off a stage further and in developing stronger visuospatial abilities they made a greater sacrifice of their verbal abilities.

The first trade-off in which males sacrificed some of their verbal abilities to secure better visuospatial abilities was relatively minor compared with the second trade-off made by the Mongoloids. Males differ from females on the visuospatial abilities by an average of around 2 IQ points (Jensen and Reynolds, 1983). For this relatively small gain males only needed to make some sacrifice of the verbal primaries of fluency and immediate verbal memory; it was not necessary to sacrifice verbal comprehension which remains as strong in males as in females (Maccoby and Jacklin, 1974; Jensen and Reynolds, 1983). The Mongoloid trade-off was more substantial. The difference between the Mongoloids and the Caucasoids on the visuospatial abilities is approximately 8 IQ points, about four times the difference between males and females. To secure an increase in the visuospatial abilities of this magnitude it was necessary to make greater sacrifices of the verbal abilities. The fluency and immediate verbal memory primaries were therefore reduced further and verbal comprehension was sacrificed as well. Hence the Mongoloid-Caucasoid differences in the verbal-visuospatial balance of abilities mirrors but exaggerates the male-female differentiation from which it developed. As was noted earlier, this thesis implies that there is a negative association between the verbal and visuospatial abilities.

# V. THE NEUROLOGY OF MONGOLOID INTELLIGENCE

The evolution of a distinctive pattern of intelligence in the Mongoloids must have entailed the development of distinctive features of the neurology of the brain. This is the problem we take up here. We consider first the neurology of general intelligence as it evolved from Australopithecus to Homo sapiens; secondly, the neurology of the verbal and visuospatial abilities; thirdly, the different neurological structures that evolved in males and females to serve their respective specializations in the visuospatial and verbal abilities; fourthly, the further neurological structures that evolved in Mongoloids in which their visuospatial abilities increased at the expense of their verbal abilities; and fifthly, the as yet unresolved problem of the slow maturation rates of the Mongoloids.

## 1. General intelligence determined by brain size and neural efficiency

When a species comes under selection pressure for an increase of its intelligence there are two ways in which the brain responds. These are, firstly, that the brain grows in size; and, secondly, that it increases its efficiency for the processing, analyzing and storing of information. The growth of brain size is the more readily apparent of these two developments. Stated quite generally, if a species has to become more intelligent to deal with the problems of survival, it needs a larger brain. This principle was stated some four decades ago by Lashley in the following terms: The only neurological character for which a correlation with behavioral capacity in different animals is supported by significant evidence is the total mass of (cortical) tissue, or rather, the index of corticalization (i.e., the ratio of brain weight to body weight) (Lashley, 1949, p.37). This position has subsequently been confirmed in detail by Jerison (1982).

There are three principal sets of data on which this principle rests. Firstly, the relationship between brain size and general intelligence, as tested for example by problem solving ability, holds over a wide range of species. Much evidence in support of this relationship has been assembled by Jerison (1982). This principle has been questioned by MacPhail (1982) but his challenge has not been considered convincing. It is clear that animals with large brains, such as apes, dolphins and mammals generally as compared with reptiles and birds, are far more efficient at solving learning set problems and insight problems of the kind originally devised by Kohler (1925) and are far less easily fooled by sign stimuli, than animals with small brains (see e.g., Mackintosh, Wilson and Boakes, 1985, for a discussion of some of these problems). Secondly, the relationship between brain size and intelligence holds between human beings. It has been estimated by Van Valen (1974) that the correlation is approximately 0.3, although Jerison (1982) considers that the correlation, although positive, is considerably lower. Thirdly, the relationship holds for the amount of cortical tissue serving relatively narrow skills, e.g., far more cortex is devoted to the motor control of the fingers than the toes and the lips than of the ears. The reason for this must be that considerably more complex skills are executed by the fingers and the lips than the toes and the ears.

The principle that greater intelligence requires a large brain came into operation when the first protohominids were forced out of the forests and obliged to survive on the open grasslands. Over the course of some 4 million years the brain grew in size approximately threefold as Australopithecus evolved into Homo erectus and finally Homo sapiens.

When the Mongoloids came under particularly strong selection pressure to increase their intelligence in order to survive during the ice ages, the most straightforward neurological adaptation would have been a further increase in brain size. However, there was a problem. To secure larger brained adults it was necessary that these should be born as larger brained babies, and this in turn required mothers with larger pelvises through which these babies had to pass. It seems that the demands entailed in this adaptation were too great to be overcome. This problem had already been encountered much earlier in hominid evolution. As we have noted, the brain grew threefold from Australopithecus to Homo sapiens, but the female pelvis did not grow threefold to permit the birth of babies with increasingly larger heads. The solution was that babies were born earlier and more immature and the head grew after birth instead of before. Thus the head of the human baby at birth remains about the same size as that of the baby ape (Tobias, 1981). Nevertheless, there seems to have been some constraint on this process of mothers giving birth to progressively more immature babies. This constraint put a stop to any further increase of brain size in Homo sapiens approximately 250,000 years ago.

Because of these problems some other process apart from increases in brain size had to evolve in response to the continuing selection pressure for improved intelligence. The brain's adaptation to this problem was to increase its neural efficiency as an information processor. It is for this reason that positive correlations are found in human subjects between quite simple measures of neural efficiency and complex intelligence tests. These simple measures of neural efficiency are of three kinds, namely the speed and accuracy of neural transmission of stimuli from the sense organ to the cortex, as measured by the evoked potential, and first demonstrated by Ertl and Shafer (1969); inspection times, e.g., the psychophysical threshold at which subjects can distinguish which is the longer of two very briefly presented lines (e.g., Brand and Deary, 1982); and simple reaction times, i.e., the speed with which a subject can press a button when presented with a visual or auditory stimulus (e.g., Carlson and Jensen, 1982). We follow Eysenck in interpreting the correlations between intelligence and these simple tasks as evidence for "the existence of a fundamental biological property of the CNS underlying success on orthodox IQ tests" (Eysenck, 1982, p. 259). This biological property is the efficiency of the neural information processing capacity. It does not appear to be crucial whether the correlations between these simple measures of neural efficiency and complex intelligence test performance are of the order of 0.8, as proposed by Eysenck, or only around 0.3, as preferred by Mackintosh (1986). The correlation of 0.3 is sufficient to sustain the theory that intelligence in Homo sapiens is a function of neural efficiency.

It is therefore proposed that when the Mongoloids came under unusually severe selection pressure for a further increase of intelligence, the most straightforward adaptation of an increase in brain size was not feasible because of the constraints outlined above. The Mongoloid brain consequently evolved the alternative adaptation of increasing its neural efficiency. There is, so far as it has been possible to ascertain, no evidence to show that Mongoloids have superior neural processing efficiency as measured by evoked potentials, inspection times or simple reaction times. Nevertheless, we follow Popper (1959) in the belief that a progressive theory generates hitherto untested predictions and this is one of the many which will be found in this paper for those who are able to carry out the necessary investigations.

## 2. Neurology of the verbal and visuospatial abilities

The starting point for the consideration of the neurology of the verbal and visuospatial abilities must be that, broadly speaking, the verbal abilities are located in the left cerebral hemisphere and the visuospatial abilities in the right. This generalization holds for the approximately 95 percent of the population who are right handed and about a third of the left handers. In the interests of simplification it will be assumed henceforth that it applies to the whole population and the 3 to 4 percent for whom the generalization does not hold will be ignored.

The specialization of the left hemisphere for the verbal abilities was first shown by Broca (1861) and has been confirmed by countless subsequent investigators. The specialization of the right hemisphere for the visuospatial abilities was first proposed by Hughlings Jackson (1876) and has also been confirmed by countless subsequent investigators (see, e.g., Bradshaw and Nettleton, 1983; Levy 1980). It may well be that some analog of these specializations of the two hemispheres appeared some 220 million years ago with the evolution of the first mammals. These early mammals were small animals, not unlike the contemporary rat, and the rat analyzes spatial information in the right cerebral hemisphere (Denenberg, 1981; Damasio and Geschwind, 1984), although what the rat analyzes in the left hemisphere does not appear to be known. There is, however, evidence that macaque monkeys analyze the vocal calls they make to each other in the left hemisphere (Petersen, Beecher, Zoloth, Moody and Stebbins, 1978). These admittedly patchy findings suggest that there may well have been an early differentiation of function between the left and the right hemispheres which served as a pre-adaptation in the evolving hominids for the localization of the verbal abilities in the left hemisphere and the visuospatial abilities in the right.

We have seen that quite early in the evolution of the hominids males began to develop stronger visuospatial abilities to improve their foraging and hunting skills and females to develop stronger verbal abilities for the rearing and education of children. In order to accommodate these respective specializations the male and female brain (more strictly, the typical male and female brain) must have developed different structures. The neurology of these developments can be envisaged at two levels of generality. Firstly, and more generally, the male brain must have allocated more cortex to the visuospatial abilities and in so doing had to allocate less cortex to the verbal abilities. The alternative trade-off must have taken place in the female brain. This inference follows from the general principle that when animals come under selection pressure for an increase in intelligence the brain responds by increasing in size. In the present case of the male and female specializations, the male brain followed this principle by increasing the amount of cortex devoted to the visuospatial abilities and the most economical way of doing this was to sacrifice some of the cortex devoted to the verbal abilities.

The second problem is what precise neurological structures evolved in the male and female brain to accommodate these two trade-offs. A number of neuropsychologists such as Levy (1974), McGlone (1980) and Bradshaw and Nettleton (1983) have pondered this problem and it cannot be claimed that any of them have formulated a solution that has commanded universal assent. Nevertheless, we adopt here the solution proposed by Bradshaw and Nettleton (1983) in order to show how a plausible neurological model can be formulated to handle the male-female differences in the verbal and visuospatial abilities and the Mongoloid-Caucasoid differences which grew out of them.

## 3. The Bradshaw-Nettleton model of the neurology of sex differences in abilities

The Bradshaw-Nettleton model states that in males the whole of the left hemisphere was allocated to the verbal abilities and the whole of the right to the visuospatial abilities. In females, the whole of the left hemisphere was also allocated to the verbal abilities, but in addition a supplementary verbal center was established in the right hemisphere. In this way males secured more cortex for their visuospatial abilities while females sacrificed some of their visuospatial cortex in their right hemisphere and used the space more profitably for an enhancement of their verbal abilities.

This model requires supporting evidence if it is to be rendered credible, and the required evidence is of two principal kinds. Firstly, in dichotic listening experiments where verbal stimuli are presented to the right or left ears, males but not females show a right ear advantage. The inference from this is that males can only process verbal input to the right ear in the left cerebral hemisphere. Verbal input to the left ear cannot be processed by the right hemisphere because males have no verbal processing center in this hemisphere and hence these stimuli have to be relayed over to the left hemisphere, thereby producing the right ear advantage. In females, however, there is no right ear advantage for verbal inputs. The reason for this is that they can process verbal stimuli presented through the left ear by the verbal center in the right hemisphere. In the case of nonverbal stimuli these sex differences are not present. Both sexes process these stimuli in the right hemisphere and hence show a left ear advantage. The same sex differences are found when verbal and perceptual stimuli are presented visually in either the right or left visual fields. All of this evidence is summarized by Bradshaw and Nettleton (1983).

The second source of evidence for some representation of verbal abilities in the right hemisphere in females but not in males arises from the differential effects of damage to the left hemisphere in causing aphasia. Left hemisphere damage has more serious effects for languages in males than in females. The inference is that females suffering left hemisphere damage can continue to use the language center in their right hemisphere. Males do not have this facility and are accordingly more seriously impaired. This sex difference in the seriousness of aphasia following left hemisphere damage has been found by a number of investigators whose work is reviewed by McGlone (1980).

## 4. Brain structure of Mongoloids

We begin by noting that the Mongoloid brain is similar in its general neurological structure to the Caucasoid brain in so far as the verbal abilities are broadly localized in the left hemisphere and the visuospatial abilities in the right (Endo, Shimizu and Nakamura, 1981). The Mongoloid brain also has the same sex differences as the Caucasoid brain, with males having relatively higher visuospatial abilities (Lynn, Hampson and Iwawaki, 1987).

These similarities would be expected from the common evolution of the two races from Australopithecus to Homo sapiens. What was required when the Mongoloids came under selection pressure during the ice ages for an increase of their visuospatial abilities was for the brain to find more cortex to accommodate this increase, and it was prepared to sacrifice some verbal abilities to achieve this end. There would probably have been two ways in which this problem was solved. Firstly, there were various miscellaneous abilities handled by the right hemisphere, such as the perceptual analysis of the howling of wolves, barking of dogs, bleating of sheep, singing of birds and insects and other animal sounds. These would have been transferred from the right hemisphere to the left, thereby freeing cortex in the right hemisphere for better visuospatial ability and at the same time sacrificing some of the verbal cortex in the left. Evidence for this and similar minor adaptations is present in the work of Tsunoda (1978) who has shown that the Japanese process a variety of sensory inputs in their left hemisphere which are processed by westerners in the right. These sensory inputs include vowel sounds, animal sounds, the singing of insects and Japanese music. Tsunoda posits a subcortical mechanical switch which directs these sensory inputs to the right hemisphere in westerners and to the left hemisphere in Japanese. If this is the case the right hemisphere in the Japanese is freed from dealing with these sensory inputs and can be devoted more fully to the visuospatial abilities, while at the same time the Japanese left hemisphere has to process these inputs and hence has less cortex for the verbal abilities. It is only fair to state that Tsunoda himself believes that the different neurological organization of the Japanese brain is acquired environmentally through the distinctive features of the Japanese language, whereas our own view on the basis of the evidence presented earlier is that the pattern of Japanese abilities and their neurological basis must have some genetic basis which may possibly be enhanced by environmental processes.

It is probable that what may be called the Tsunoda solution was not sufficient and that the Mongoloid brain needed to evolve a further adaptation to devote further cortex to the visuospatial abilities. It is proposed that it accomplished this by the establishment of a supplementary visuospatial center in the left hemisphere. The effect was that the Mongoloid left hemisphere retained the long established hominid function of serving the verbal abilities but these were slightly reduced by the encroachment of the visuospatial abilities. This pattern of neurological organization would therefore be the converse of the Bradshaw-Nettleton model of the neurological structure of Caucasoid females.

Experimental evidence supporting this theory of the neurological structure of the Mongoloid brain has been provided by an investigation by Hatta and Dimond (1980). In this study two experiments are reported comparing Japanese students in Osaka with British students in Cardiff. In the first experiment sequences of six digits were presented for two seconds in the left and in the right visual fields. Both Japanese and British subjects perceived the digits more accurately in the right visual field than in the left and there were no significant differences between them. Our interpretation of this result is that both Japanese and British subjects process verbal input in the left hemisphere, to which stimuli presented in the right visual field are directly relayed, and for this reason are perceived more efficiently. In the second experiment what are described as "random forms," i.e., irregular geometric shapes, were presented in the left and right visual fields, in the same way as with the digits in the first experiment. The British students perceived the shapes more accurately in the left visual field, but the Japanese students perceived the shapes with equal accuracy in both visual fields. Our interpretation of this result is that the British students could only analyze these visual stimuli with the right hemisphere, thereby giving a left visual field superiority. The Japanese students, having visuospatial processing centers in both hemispheres, perceived the stimuli equally well in the left and right visual fields. The total accuracy score of the Japanese students was higher than that of the British by approximately half a standard deviation. This would be expected and is the order of the superiority of the Japanese on visuospatial tasks, but in this case the number of subjects was too small (30 from each group) for the difference to reach statistical significance.

## 5. The slow maturation of Mongoloids

We come now to the problem of the slow maturation of Mongoloids which, as we noted earlier in this paper, is present at birth, in infancy and in early childhood up to the age of around 5 years. In this regard the Mongoloid-Caucasoid difference once again mirrors the male-female difference, since males and Mongoloids are both slow maturers and have high visuospatial abilities as compared with females and Caucasoids. It is probable that the explanation for these parallels is that the Mongoloid brain used the same endocrinological mechanism to secure its high visuospatial abilities as had evolved earlier in hominid evolution in males for the same purpose. These mechanisms appear to be that the relatively low levels of androgen and estrogen in females are responsible for fast maturation, as Ounsted and Taylor (1972) and Waber (1979) have proposed. The suggested mechanism is that the verbal abilities develop in infancy before the visuospatial abilities. Hence the faster maturation in girls leads to the rapid establishment of verbal abilities in both the left hemisphere and in a supplementary center in the right. In boys slower maturation delays verbal development and allows the visuospatial abilities to establish themselves throughout the right hemisphere (Bradshaw and Nettleton, 1983; Corballis, 1983.)

The role of androgens and estrogens in this process is inferred from three strands of evidence. Firstly, females with Turner's syndrome are exposed to unusually low fetal levels of androgen and estrogen and develop an exaggerated version of the female cognitive profile consisting of normal verbal abilities but weak visuospatial abilities (Rovet and Netley, 1980). Secondly, the converse pattern is shown by females with congenital adrenal hyperplasia. This disorder increases prenatal androgen levels and produces females with enhanced spatial ability (Resnick, Berenbaum, Gottesman and Bouchard, 1986). Thirdly, the critical role of faster maturation in girls as a determinant of the female high verbal-low visuospatial ability profile is suggested by a study of triple X chromosome females. The triple X chromosome slows growth rates and produces females with the masculine profile of low verbal-high visuospatial abilities (Rovet and Netley, 1983).

The faster maturation rates of females in infancy and early childhood are well established and are present for physical growth, motor development, verbal development and general cognitive abilities. In physical growth, the skeletal age of girls at birth is 4-6 weeks ahead of boys, and they retain this lead until adolescence (Tanner, 1970). The earlier physical maturation of girls is followed by earlier development of motor skills (Denckla, 1973, 1974) and of language, where by the age of 18 months girls are significantly ahead of boys (Moore, 1967). Even in the visuospatial abilities girls are slightly ahead of boys at the ages of 4-6 years as assessed by the performance scale of the WPPSI (Kaiser and Reynolds, 1985). One of the most valuable of these studies of sex ditterence is the analysis of the McCarthy Scales standardization sample by Kaufman and Kaufman (1973). They found that girls were uniformly and significantly ahead of boys over the age range 2½-8½ years by approximately 2.7 IQ points on all five of the scales measured by the test, i.e., the general cognitive index (general intelligence), the verbal and visuospatial abilities, numerical ability and motor development. This result suggests a general maturation acceleration in girls affecting all aspects of cognitive and motor development. Further studies indicating the accelerated maturation rates of girls are reviewed by Wolff (1981). From the age of about 6 years girls begin to display the high verbal-low visuospatial ability pattern. Their high verbal abilities are most prominent in verbal fluency and in immediate verbal memory, tested by digit span where girls have virtually invariably been found superior to boys, but their advantage does not typically appear in verbal comprehension (Maccoby and Jacklin, 1974; Jensen and Reynolds, 1983). At the same time girls begin to display weaker visuospatial abilities as measured by the performance subtests of the WPPSI and WISC-R (Kaiser and Reynolds, 1985; Jensen and Reynolds, 1983). Hence males and Mongoloids are similar, as compared with females and Caucasoids, in regard to their slow maturation and their weak verbal-strong visuospatial ability profile. The proposed explanation for these parallels is that when Mongoloids came under selection pressure for an increase of their visuospatial abilities they developed further the endocrinological mechanisms which had already evolved in males to secure stronger visuospatial abilities. Mongoloids would therefore have evolved greater androgen and estrogen outputs during pregnancy. This would act on the fetus to slow down the maturation rate prenatally in infancy and early childhood. This theory is offered as the probable physiological mechanism by which the slow maturation of Mongoloids is linked, as it is in males, with their weak verbal-strong visuospatial ability profile.

## VI. PSYCHOMETRIC ANALYSIS OF THE TRADE-OFF BETWEEN THE VERBAL AND VISUOSPATIAL ABILITIES

It is now time to address a problem which has no doubt been present in the minds of many readers, namely what psychometric evidence can be marshalled to support the theory that a trade-off evolved between the verbal and visuospatial abilities. It will be recalled that it has been proposed that this trade-off occurred twice in the evolutionary history of the hominids: firstly, when the male australopithecines traded some of their verbal abilities to secure an increase of their visuospatial abilities; and secondly, when the Mongoloids traded more of their verbal abilities to secure a greater increase of their visuospatial abilities.

It has already been noted that the terms male and female brain and Mongoloid and Caucasoid brain are used as simplifications for what is more strictly a continuum running from high verbal-low visuospatial individuals (predominantly females and Caucasoids) through generalists to low verbal-high visuospatial individuals (predominantly males and Mongoloids). It is clear that this thesis implies that there must be a negative association between the two sets of abilities, such that the stronger the one, and in neurological terms the more cortex devoted to it, the weaker must be the other, and the less cortex devoted to it. The problem is therefore to show in psychometric terms that these two sets of abilities display the negative association demanded by the theory.

This possibility has rarely been considered by psychometricians who are used to examining matrices of correlation coefficients between tests of various cognitive abilities and noting that these coefficients are invariably positive. This was first shown empirically by Spearman (1904) and proposed by him as a general law which he designated the law of positive manifold. Psychometricians have either followed Spearman or the alternative thesis advanced by Thurstone (1938) in his earlier work to the effect that the primary abilities are independent.

The third possibility that the relationship between some of these abilities might be negative has never, so far as I am aware, been seriously argued. The difficulty in demonstrating that there is a negative association between the verbal and visuospatial abilities lies in the ubiquitous and powerful operation of Spearman's g, which forces all abilities into positive relationships. The nature of Spearman's g should probably be considered twofold. Firstly, it consists of some general physiological properties of the brain, of which, as has been proposed above, size and neural efficiency are the most probable characteristics. Secondly, physiological components of Spearman's g will be strengthened by common environmental variance acting on all cognitive abilities, i.e., favorable environments will tend to raise all cognitive abilities and bring them into positive intercorrelation.

The problem for one who wishes to demonstrate the existence of a negative relationship between the verbal and visuospatial abilities is therefore to remove the effects of Spearman's g. There are two ways in which this can be done. Firstly, it is possible to take a population which is homogeneous for Spearman's g. A study which goes some way towards meeting this requirement has been reported by Stafford (1972). His subjects were all freshmen at an American university. These would be drawn from the upper part of the intelligence distribution and so would be relatively homogeneous for Spearman's g. Stafford computed the correlations between the freshmen's scores on a test of visuospatial ability and their grades in 10 modern language courses. All correlations were negative. The highest negative correlations were of the order of -0.20 to − 0.25 and were statistically significant in themselves, and the whole set of results is clearly highly statistically significant.

Another study of this kind has been reported by Smith (1964). The subjects were English children in the town of Oldham who took tests of verbal and spatial intelligence at the age of 10 years for selection to grammar schools and were successful. These children would have comprised approximately the top 15 percent of the ability range and hence were fairly homogeneous for Spearman's g. Five years later these children took the English public examination known as the General Certificate of Education (GCE). The correlations between the intelligence test scores taken at age 10 and the scores in various subjects in the GCE examination were then computed. It was found that spatial ability at age 10 was consistently correlated positively at around 0.40 with examination performance in mechanical science, metal work, art and mathematics but negatively correlated at around -0.25 with subjects with a large language component including English language, English literature, German, chemistry, and biology (the last two subjects being examined by essay questions and hence demanding verbal ability). It will of course be noticed that these two studies could not have succeeded in achieving the complete removal of Spearman's g, which would certainly be present among any set of American university freshmen and English children passing the grammar school selection examinations. What these two investigations did achieve was a sufficient reduction of the variance of Spearman's g to reveal the true negative relationship between the verbal and visuospatial abilities. It can be inferred that if Spearman's g had been more completely removed the negative correlations would have been greater.

A second strategy for an attack on this problem is to use a normal representative population and attempt to remove Spearman's g statistically. A simple and straightforward way of doing this is to calculate the partial correlations between the verbal and visuospatial abilities, partialling out Spearman's g. We have adopted this strategy for the standardization data of the WISC-R and the WPPSI. For the WISC-R data, Spearman's g is estimated from the first factor derived from the Schmid-Leiman factor analysis computed by Jensen and Reynolds (1982). These authors consider this first factor to be a measure of Spearman's g and we agree with them. The verbal abilities are best represented by Vocabulary, a measure of the verbal comprehension primary, and by Digit Span, a measure of immediate verbal memory, which are respectively the highest loading tests on these two primaries. The visuospatial abilities are best represented by Block Design which is the highest loading test on the visuospatial factor. We therefore predict that the partial correlations between the Block Design and Digit Span and between Block Design and Vocabulary will be negative. The partial correlations for males and females separately are shown in the first four rows of Table 4. It will be seen that, as predicted, all four partial correlations are significantly negative.

The second set of data used for the examination of these predictions was the WPPSI. Here Spearman's g is estimated from the first principal factor calculated by Kaiser and Reynolds (1985), the verbal comprehension primary from the Vocabulary test, immediate verbal memory from the Sentences (a test in which the child has to repeat a sentence), and the visuospatial abilities from the Mazes test, a well known test of the visuospatial abilities. The predicted negative partial correlations calculated for males and females separately are shown in rows 5-8 of Table 4 and once again it will be seen that all four are significantly negative.

Lest the skeptical reader should suspect that any pair of tests plucked out of these sets of data would yield negative partial correlations, we have calculated the partials between pairs of tests of visuospatial abilities (viz. Block Design and Mazes in the WISC-R and Block Design and Picture Completion in the WPPSI), and between pairs of tests of verbal abilities

**Table 4** Partial correlations between selected subtests from the WISC-R and the WPPSI after Spearman's g has been partialled out

| Population | Tests | Partial correlations |
|---|---|---|
| WISC-R, males | Block Design × Digit Span | −10* |
| | Block Design × Vocabulary | −28** |
| WISC-R, females | Block Design × Digit Span | −07* |
| | Block Design × Vocabulary | −25** |
| WPPSI, males | Mazes × Vocabulary | −24* |
| | Mazes × Sentences | −25** |
| WPPSI, females | Mazes × Vocabulary | −14* |
| | Mazes × Sentences | −16* |
| WISC-R, males | Block Design × Mazes | +11* |
| | Digit Span × Vocabulary | +01 |
| WISC-R, females | Block Design × Mazes | +17* |
| | Digit Span × Vocabulary | −05 |
| WPPSI, males | Similarities × Sentences | +06 |
| | Block Design × Picture Completion | −03 |
| WPPSI, females | Similarities × Sentences | +09* |
| | Block Design × Picture Completion | −02 |

One and two asterisks indicate statistical significance at the 5% and 1% levels respectively. Decimals are omitted.

(viz. Digit Span and Vocabulary in the WISC-R and Similarities and Sentences in the WPPSI). These partial correlations are shown in rows 9-16 of Table 4. it will be seen that none of them is significantly negative and three are significantly positive. These results are consistent with our theory: the theory does not predict that one micro verbal ability or micro spatial ability is traded off against another, and hence there should be no negative associations between the micro abilities within each of the two families of the verbal and visuospatial abilities.

We conclude that the negative partial correlations shown in rows 1-8 of Table 4 are sufficiently strong to demonstrate the correctness of one of the central theorems of the theory advanced in this paper, namely that during the evolution of the hominids a neurological trade-off took place twice, the first when males sacrificed some of their verbal abilities to secure improved visuospatial abilities and the second when Mongoloids sacrificed more of their verbal abilities to secure further improvements in their visuospatial abilities. These trade-offs entailed the negative relationships between the two sets of abilities whose existence, once the effects of Spearman's g have been removed, has been shown in this section.

## VII. CONCLUSIONS

This paper has been concerned with four objectives. Firstly, it was considered that the existing data base for theories of the causes of racial differences in intelligence has been too narrow insofar as it has been principally confined to differences between Caucasoids and Negroids in the United States. Secondly, these differences have been largely discussed in terms of general intelligence considered as a single entity and relatively little attention has been paid to racial differences in the more specific abilities. It is true that Jensen has done something to widen the data base by providing evidence on the intelligence of other racial populations in the United States and on the more specific abilities differentiating the races and the socio-economic classes (Jensen, 1973a, 1973b; Jensen and Reynolds, 1982). Nevertheless, these data have been largely ignored by environmental theorists.

The first part of this paper was therefore concerned with extending the data base on racial differences in intelligence by documenting the characteristics of the intelligence of Mongoloids. It is shown here that the Mongoloids in Japan, the United States, and, so far as the evidence goes, in Hong Kong, Singapore and Taiwan, are characterized by high values for Spearman's g, low verbal abilities, high visuospatial abilities, and slow maturation rates. The result of these generalizations is that the data which require explanation by environmental and genetic theories are extended to Mongoloids and to the distinctive pattern of Mongoloid abilities in addition to their general intelligence. This part of the paper concludes with the proposition that it is not possible to construct an environmentalist theory capable of explaining the totality of the data.

The third objective of the paper has been to present an evolutionary theory for the Mongoloid pattern of abilities. It is proposed that the crucial selection pressure responsible for the Mongoloid pattern of abilities was the extreme cold of the ice ages and that the four characteristics of Mongoloid intelligence can be understood as adaptations to this pressure. The high Spearman's g and strong visuospatial abilities are considered as direct adaptations conferring selective advantage in these severe conditions, while the weak verbal abilities and slow maturation rates were explained as indirect consequences of these adaptations.

The fourth objective of the paper has been to present a neurological theory of the distinctive brain structure that must have evolved in Mongoloids as a result of these adaptations. It is proposed firstly that the Mongoloid brain would have developed an improvement in general neural efficiency and secondly that it would have devoted more cerebral cortex to the visuospatial abilities at the expense of cortex devoted to the verbal abilities. A theory is offered of the details of these distinct neurological structures in Mongoloids.

All the theories advanced in this paper have been formulated in such a way that they yield many predictions for further investigation. The empirical base of the theory can be tested by further studies of the ability profiles of Mongoloid and Caucasoid populations in different geographical locations, including the Far East and Europe. The evolutionary theory can be tested by the investigation of the abilities of other racial populations, such as the Negroids, the American Indians, and the Australian aborigines, who have been exposed to their own distinctive selection pressures. The neurological theory can also be subjected to further empirical testing. This paper has been concerned only with Mongoloid-Caucasoid differences in abilities, but it is believed that the theories advanced provide an economical and comprehensive framework in terms of which further racial differences in abilities can be understood and explored.

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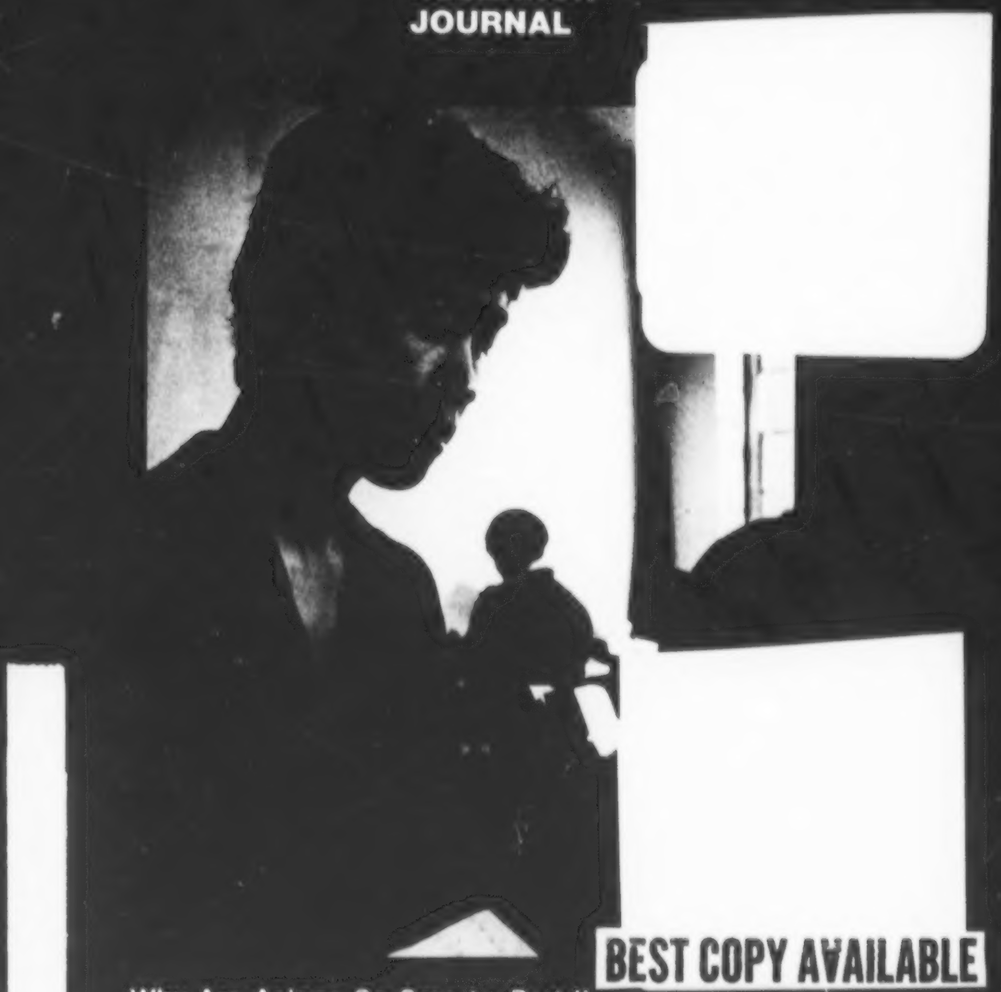

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## Why Are Asians So Smart—Part II

Commentary on "The Intelligence Of The Mongoloids: A Psychometric, Evolutionary and Neurological Theory"

by Richard Lynn

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**Staff:**

*Editor* • Phyllis Miller, 23 Lexington Road, Somerset, NJ 08873

*Production Assistant* • Carrie Martin, 2284 Pressler Road, Akron, OH 44312

*Circulation Manager* • Karolyn Silliman, 19340 Dunbridge Way, Gaithersburg, MD 20879

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# Editor's Preface

Those of you who are familiar with scholarly journals know that those which are most respected are refereed; that is, before articles are accepted for publication, they are read by authorities in the field of specialization and approved or rejected based on the quality and timeliness of the research they describe. The Mensa Education and Research Foundation lacks such a board of experts, and therefore the *Mensa Research Journal* generally publishes articles that have appeared in journals previously or that have been presented at professional conferences or meetings. In this issue, however, we have departed from that custom, and I am delighted to be able to present new, original material written expressly for the *MRJ*.

When we spoke with Richard Lynn about his article on the intelligence of East Asians which appeared in our last issue, we realized it would generate some controversy, and agreed to ask a group of scholars in the field to comment on it. Herewith is their commentary, with a response by Professor Lynn. Needless to say (but I'll say it), if you haven't read issue 23, you'll be hopelessly confused by reading this one. If that's the case, I urge you to send $5 to Karolyn Silliman, our circulation manager, and request a copy of number 23. The two are companion pieces.

Having heard from several authorities on Professor Lynn's theory, we encourage all our readers, authorities or not (anyone in Mensa not an authority?), to comment as well, and we plan to publish letters on this topic in the next issue.

Once again, let me caution readers that the word Mongoloid in this context means Asian, just as Caucasoid means White and Negroid means Black. Forewarned, read on, and then add your own fuel to the flames.

Phyllis Miller
Editor

# Letters

**To the Editor:**

I can see where a conservative journal might consider Richard Lynn's work "controversial" . . . but I trust it is more for his fanciful use of the evolutionary theory to explain differences in racial IQ, than for the fact of the differences themselves. I suspect you will get more comment on those differences (the familiar "knee-jerk reaction" from those who either haven't kept up with IQ investigations, or who choose to ignore facts) than from the almost-Velikovsky flight of imaginative "deduction" with which Lynn "explains" the differences. Time, and future findings, will tell if Lynn is also vindicated (or partially, as Velikovsky was).

Perhaps one of the more telling parts of Lynn's saga is the glancing reference to physical differences among the races (the shortening of the limbs of the Mongoloids). Given the concept of "race," and in view of pigmentation, musculature and biochemical ("genetic" diseases) differences, perhaps the wonder is why anyone would presume an equality of IQ. And this should be most obvious in Male-Female comparisons (admittedly NOT a racial issue).

You are to be commended for bringing what I had considered a closed issue to popular light. Research should continue in the field. Yet I trust that our species would be better served if we recognized, properly utilized and celebrated ALL racial differences (IQ and otherwise) for the betterment of all.

The only quibble I have with the investigations so far is the apparent ignoring of the "native language" factor. I believe that the language one thinks in actually structures his thinking process and itself limits possible solutions and options. I do not recall any of the tests, particularly of American-residing Mongoloids, factoring in the language really used by the population tested. "Babel" could be startingly important!

John B. Ceccherelli
National Coordinator
Mensa Gifted Children Programs
918 Forest Rd.
Endwell, NY 13760

**To the Editor:**

I have read Richard Lynn's article in the Winter 1988 *Mensa Research Journal* with considerable interest. My impression is that assumptions crucial to the validity of the thesis are advanced as fact without any supporting evidence. Specifically, Lynn discounts the effects of environment based on the relative incomes of the two groups. That is absurd, as it ignores differences in diet (prenatal and neonatal nutrition are widely believed to be related to brain development) and any differences in modes of interaction between family members. Lynn also asserts that the test data is a valid basis for comparison, but all he presents is the test results and the statement that they support his contention. The results do show the patterns he says, but the same pattern could result from a consistent and unidentified bias within the tests. Even assuming that his conclusions about what the tests say are correct, demonstrating that the differences are genetic in origin is impossible with the available data.

I do think the causes of differences between individuals or groups are worth studying, for many reasons. I do not think Lynn's article adds anything useful.

As one whose contributions presumably keep *MRJ* alive, I am concerned about my money being used to support such dubious work. I am also alarmed by the idea that this is controversy simply for the sake of controversy. If *MRJ* is indeed a "research journal" then it should follow the accepted practices of such journals and require that papers be read by competent referees. If that was done with Lynn's paper, there's no mention of it. Perhaps MERF's limited resources would be better spent awarding scholarships or sponsoring colloquia.

Peter W. Spearing
53 Heights Ave.
Northfield, OH 44067-1324

EDITOR'S NOTE: Because the *MRJ* has no referees of its own, it publishes material that has previously appeared in refereed journals. Lynn's article appeared in *Personality and Individual Differences*, 1987, 8, 813–844, as stated in the last issue on the first page of his article.

**To the Editor:**

Congratulations on your decision to reprint Richard Lynn's brilliant and fundamental article on the possible neurological and evolutionary causes of racial differences in intelligence.

I have a few queries and critical comments concerning the Lynn article:

1. The case for higher Japanese than U.S.-European IQ seems proved as to Spearman's g and visuospatial brain. The evidence on the IQ of overseas Chinese suggests the broader conclusion of Mongoloid visuospatial brain advantage over Caucasoids, but is cast in doubt by the selective factors dominating Chinese emigration. Moreover, we know next to nothing about the IQ levels of China's hundreds of millions of peasants, nor are the mental achievements of Central Asian Mongoloids impressive. This suggests agnosticism while awaiting more evidence.

2. Lynn's argument that the need to plan and prepare for severe winters may have winnowed out the stupid and feckless and hence produced a superior Mongoloid to Caucasoid gene pool seems valid. His assertion that the need for keen spatial perception in hunting over snowbound terrain would lead to evolutionary selection for visuospatial mind is more dubious. First, because the primitive hunting people of the Kalahari, Australian and Arabian deserts had the same survival need for acute visuospatial perception, yet this has not produced a generation of desert mathematicians and scientists. Second and more fundamentally, Lynn posits a displacement of verbal by visuospatial brain. Yet prolonged infancy, the complex survival needs of amassing food, making clothing and providing shelter for harsh winters would suggest the need for much more complex verbal communication to educate the young for survival, hence a stress on verbal as well as visuospatial brain.

3. An alternate theory worth considering and perhaps worth reprinting in *MRJ* is that of A. Philippe Rushton of the psychology department of the University of Western Ontario. He argues that the three major races differ in basic survival strategy: Mongoloid low fertility and sexuality coupled with slow infant maturation, intense care of children, strong familial and societary bonds, stress on education for survival, and achievement of high intelligence vs. the alternate strategy of high fertility and sexuality with feckless parenthood, defective infant care, lower education and IQ. All this is perhaps best expounded in Rushton's "Race differences in sexual behavior: Testing an evolutionary hypothesis," in *J. of Research in personality* (1987).

I am deeply interested in the respective merits of the Lynn and Rushton theories since I am finishing a book on profiles of achievement in the contemporary United States. The superiority of Chinese, Koreans and Japanese in math and science is startling. If Rushton is correct, this should in time extend to the disciplines calling for verbal intelligence; if Lynn is right, it will not.

Nathaniel Weyl
855 Oleander St.
Boca Raton, FL 33486

(Continued on Following Page)

# Some Doubts on the Evolution and Pattern of Mongoloid Intelligence

*Christopher Brand*

Department of Psychology, University of Edinburgh, Scotland

Dr. Lynn must be congratulated on an engaging theory that probably borders on the falsifiable — always a major achievement in psychology. Yet a strain on credulity is involved. Can the Mongoloids really be low in verbal ability when they can master Indo-European languages much more easily than Caucasoids can master theirs; when the average Japanese reads a daily newspaper equivalent in difficulty level to the London *Times* (Furuki, 1984); and when China was the world's first mass-literate culture (Thomas, 1979), employing written examinations on a vast scale long before the year 1869, when Britain's Civil Service was first thrown open to literate talent? In any case, psychometric comparison of cultures cannot seriously be made for "verbal abilities" when the Wechsler Scale of Intelligence for Children asks "Who discovered America?" and "What is a belfry?" — questions on which Scottish children at least have shown a marked decline in performance over just the last 22½ years (Brand, Freshwater, Dockrell and Palairet, 1987).

Again, with regard to Lynn's evolutionary theory of inhospitable conditions leading to the development of hunting rather than of domestic skills, how is it that Bushmen and the Australoids did not come by a high-spatial and low-verbal profile in the course of facing up to their own equally unpropitious environments? Or, if the hunting life once generated male superiorities in P-V for mankind in general, why has the higher Mongoloid exposure to this lifestyle not yielded bigger male advantages in P-V amongst Mongoloids than Lynn has been able to record? Moreover, as to cerebral lateralization (quite apart from reports like that of Endo, Shimizu and Hori, 1978, indicating Japanese cerebral lateralization of function to be entirely normal), it would seem a little premature to speculate about any exotic lateralization of Mongoloids when no serious estimate is available from demonstrably representative samples of even their patterns of handedness and eye dominance. One can say the same about Mongoloid IQ: sadly — reflecting unhappily on a modern economy upon which worldwide psychological interest has been focused for ten years — there

**CHRISTOPHER R. BRAND**, a native of England, was educated at Queen Elizabeth Boys' Grammar School, Barnet, and at the Queen's College, Oxford. He holds an M.A. (Oxon) degree in psychology and philosophy and has worked as a prison psychologist at the United Kingdom Home Office and a research fellow in social psychology at Nuffield College, Oxford. Since 1970 he has been lecturer in psychology at the University of Edinburgh. A specialist in differential psychology and supporter of the "London School," he provided some of the earlier reports of substantial correlations between IQ and "inspection time" (a measure of elementary perceptual intake speed).

has yet to be a study of IQ in Japan that involves anything more than a best guess as to its sampling adequacy. Evidence of low verbal IQ in American Orientals provides little substitute without there being any proper control for the frequency of bilingualism; and, when 37 percent of American Orientals meet entrance requirements for the University of California, as compared to 17 percent of Caucasoids and 8 percent of Negroids (Vernon, 1982), it requires a considerable distrust of university selection procedures to believe that the population that yields such successful Orientals is truly 'low-verbal.'

Beneath these uncertainties there may lurk some important truths which careful attention to Lynn's work may reveal. For example, it is certainly arguable that Mongoloids have high spatial abilities. Noble (1978) once summarized the literature to this effect; and, together with high levels of Independence, they may be rather low in Pathemia, as is suggested by their high scores on Eysenck's Psychoticism scale (especially if their high Lie scores, which would normally depress Psychoticism scores, are borne in mind) (Eysenck & Eysenck, 1976, pp. 197-9; Morris, 1979; Low and Shomi, 1982; Gong, 1984). Overall, they may tend towards a general tough-mindedness and realism by Western standards. Yet the most noticeable features of the Mongoloids are their high Control (and Lie) levels (by Western standards) and their high level of Anxiety: in childhood, Japanese children present virtually no behavioral problems of the acting-out, extroverted type (Vernon, 1982); and the idea that Mongoloids tend towards restraint and propriety in their dealings is probably fairly widely acceptable even to non-psychometricians.

Unfortunately, this must pose a serious problem for Lynn's theory: psychometricians would normally expect such a well controlled, non-psychopathic personality type to be associated with a P<V ability profile rather than with one of P>V (Wechsler, 1944; Schafer, 1948; Critchley, 1968; Kahn, 1968). Robinson (1985) has particularly linked P-V to lack of Control and to Exvia: on this account, Mongoloids would have to appear as generally extroverted if they were indeed high in P-V. Lynn could perhaps reply that P-V discrepancies have often seemed associated with creativity (especially perhaps in the arts and psychology: Willerman, 1979, p. 342; Roe, 1983; Lloyd-Bostock, 1979) rather than with the scientific competence that is presently so remarked upon in the Japanese and that is thus in line with their P>V profile. But it seems clear that the leverage given by the P-V difference on major features of Mongoloid character will turn out to be slight.

Perhaps Lynn's own talent for pellucid sociobiological theorizing would have been better deployed in defense of his original engaging attribution of the Japanese success story to high Anxiety (Lynn, 1971). His present theory is sociobiologically ingenious but it requires more sober enquiries that can only be undertaken when the educational bureaucracies of advanced countries are overturned by scholars who believe in sampling and measurement, and who do not invariably assume that socio-economic factors must be the major causes of human differences. There are, surely, more important dimensions of the human condition than that of economic "advantage" vs. "disadvantage," but whether such dimensions consist essentially in "race" as a super-variable must remain a moot point that those who theorize about group differences should at least consider.

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# Positron Emission Tomography and the Neurobiology of Intelligence

*Ian J. Deary*

Department of Psychology, University of Edinburgh, Scotland

Professor Lynn is to be congratulated for his scholarship in producing a theory which accounts for much empirical evidence and which is bold enough to make specific predictions about the neurological substrates of racial differences in intelligence performance patterns. Thus Lynn provides testable hypotheses that may be refuted by the examination of differences in localization of cognitive functions in Mongoloids and other races. In this brief commentary I shall focus on the prospects for testing this key prediction.

Lynn hypothesizes that typical right hemisphere tasks are performed by a part of the left hemisphere in Mongoloids. Therefore, given that we know which brain areas normally perform certain tasks, we should look for departures from this pattern in Mongoloids. Unfortunately, the most convenient method for testing this hypothesis, that of examining the performance of patients with well localized brain injury, is not sufficiently sensitive or specific. For instance, Warrington et al (1986) examined Wechsler Adult Intelligence Scale results from 656 patients with unilateral brain lesions and found that, while left hemisphere lesions produced reliable verbal IQ decrements, right hemisphere lesions did not produce reliable performance IQ decrements. Moreover, brain injury is rarely well defined: supposedly damaged areas may retain some function while supposedly intact areas may have suffered diffuse injury that is difficult to detect with current methods.

A more direct method of testing Lynn's localization hypothesis, that may be used with normal volunteers, is positron emission tomography (PET) scanning (see Heiss et al., 1986 and Gordon et al., 1986 for accounts of PET scanning in psychiatry and neuropsychology, respectively). Although it is costly and demands highly sophisticated equipment and technical backup, the principles of PET scanning are simple. Brain cells are largely dependent on glucose for their metabolism. The functioning of brain areas may be indexed by their rate of glucose metabolism: the more active the area, the more glucose will be utilized. In PET brain scanning a subject is given an intravenous injection of a known amount of a glucose analog which is tagged with a radioactive label: often $F^{18}$ labelled fluorodeoxyglucose is used. A metabolite of fluorodeoxyglucose accumulates in brain cells in proportion to the amount of glucose metabolism carried out by the cell.

**IAN DEARY** graduated in medicine, psychiatry and subsequently in psychology at the University of Edinburgh, where he is now a lecturer. He has published work in the neurophysiology of intelligence.

The accumulated metabolite emits positrons whose collisions are detected and converted using mathematical models to a three-dimensional picture of the brain's glucose metabolism.

Chase et al. (1984) carried out $F^{18}$ labelled fluorodeoxyglucose brain positron emission tomography on 17 mildly affected Alzheimer patients and five normal controls. All subjects had completed the WAIS previously and PET scanning was done while subjects were at rest. The group had a mean full-scale IQ of 95 (SEM = 5). The mean verbal IQ was 97 (range 61 to 138) and the mean performance IQ was 93 (range 52 to 136). The correlations between overall resting cortical glucose use and IQ scores were as follows: $r = 0.68$ (p.0.0008) for full-scale IQ; $r = 0.61$ for verbal IQ; and $r = 0.56$ for performance IQ (p.0008). Further, verbal IQ correlated most highly with glucose metabolism in the left hemisphere ($r = 0.68$) and within the left hemisphere, most highly with metabolism in the left temporal region ($r = 0.76$). Performance IQ correlated most highly with right hemisphere glucose metabolism ($r = 0.61$) and within the right hemisphere, most highly with metabolism in the right parietal region ($r = 0.70$). The same pattern was obtained when the normal controls and Alzheimer patients were analyzed separately and when a group was formed from the 5 normal controls and the 5 least demented patients.

More detailed analyses of WAIS subtest localization showed, for instance, that block design was significantly correlated with glucose metabolism in the right parieto-occipital area and the arithmetic subtest was most closely associated with glucose metabolism in the left temporo-parieto-occipital junctures.

Further studies along these lines are being carried out in normal controls (e.g., Haier et al., 1987) and this may lead to more exact cognitive test localization maps being constructed. Departures from the typical Caucasoid pattern will be easy to test in Mongoloids. From Lynn's work one might suggest that the WAIS-glucose metabolism correlations of Mongoloids would show more performance IQ correlations with metabolism in the left hemisphere. Also, with serial PET scanning (Cutler et al., 1985) Lynn's developmental ideas may be tested and hemispheric localization of cognitive function may be traced from childhood if the radioactive tracers are deemed sufficiently safe. Using PET scanning to localize cognitive functioning may provide a relatively unequivocal test of Lynn's localization hypothesis.

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# New Light on Racial Differences in Intelligence

*H.J. Eysenck*

Institute of Psychiatry, University of London, UK

Several decades have been wasted on relatively meaningless controversies regarding the intelligence of whites and blacks in the United States, arguing about the genetic or environmental causes for the observed differences of 15 points or so between the two groups (Eysenck, 1984). Richard Lynn has greatly advanced the discussion of racial differences in intelligence in three major ways. In the first place, he has demonstrated that while whites on the average tend to have higher IQs than blacks, Mongoloid groups tend to have higher IQs than whites. These findings seem to do away with the objection made that differences in IQ between races are due to the fact that tests are made by white, middle-class experimenters. If this were so, then Mongoloid groups should not be more successful than white groups in doing IQ tests made by white middle-class psychologists! There are reasons for doubting the adequacy of the alleged explanation; we will come to these presently.

The second important advance that Richard Lynn has made has been his insistence on looking not only at IQ, but at the pattern of abilities differentiating different races. He has shown that Mongoloids, as compared to whites, show particularly strong visuospatial abilities, and rather inferior verbal abilities; this is an important additional finding to that simply comparing the groups for general intelligence. It is all the more interesting because it has been found that among American blacks the opposite pattern obtains, i.e., they are relatively better at verbal tests, and relatively worse on visuospatial tests. This would also seem to disprove the hypothesis that the race of the test constructor is relevant; if that were so, blacks should be disadvantaged on verbal tests, rather than on visuospatial ones!

The third great advance that Richard Lynn has made has been to suggest a causal hypothesis for the observed differences. He suggests that the crucial selection pressure responsible for the Mongoloid pattern of abilities, and their high IQ, was the extreme cold of the ice ages, and that their particular pattern of intelligence can be understood as adaptation to this pressure. Conversely, one might argue that the opposite features demonstrated by blacks result from the lack of such pressure due to their behavioral position in a relatively hot climate. It is of course difficult, and it may be impossible, to prove directly such evolutionary hypotheses, but circumstantial evidence certainly suggests their feasibility. Some such circumstantial evidence is presented by Richard Lynn, and lends strong support to his argument.

**HANS J. EYSENCK** was educated in Germany, France and England. He graduated in psychology from the University of London, from which he also received Ph.D. and D. Sc. degrees. For most of his working life he has been professor of psychology at the Institute of Psychiatry at the University of London. He has published 30 books and more than 500 papers on personality and intelligence.

One great advantage of looking at differences between ethnic groups in this way is that it leads us away from the question of racial superiority to the much more interesting one of causal factors in the differentiation of different groups. Thus, for instance, the Scots have been found to have a decreasing IQ because of the emigration of their brightest and most successful citizens to the United States, and Ireland also seems to have suffered in that way. In other words, national or racial groups are not static; they change over time due to causes which can be researched and understood, and there is no inevitability about their IQ level.

A good example of this rather novel tendency to explain differences in terms of evolutionary or historical causes is the surprising success of the Jews in the American culture, and the high degree of intelligence which they have shown, as made clear in Weyl's book (1966). Three possible historical explanations may account for the high intelligence and the great success of the Jews. The first is the fact of their persecution over the pat 2,000 years. Persecution puts a premium on high intelligence to detect the first signs of danger, to avoid the persecution, and to create a new life somewhere else. Those most successful in doing this would be likely to have higher IQs than those who fail, and in that way the gene pool of the group would be improved.

A second plausible reason is the fact that among the Jews rabbis are very highly regarded, are required to marry and have as many children as possible, and because of their high status have a wide choice for marriage partners among the rich and more successful, who also would be likely to have a high IQ. This stands in contrast to Catholics, whose clergy is forbidden to marry and have children, thus eliminating from the gene pool many of the very brightest.

A third historical reason is the fact that during the 18th and 19th centuries German and Austrian governments, afraid of the high birth rate among Jews, passed laws allowing only the first born to marry and have children, but also giving permission for later born children to marry if they could pay a certain marriage tax. In other words, again the more successful and consequently brighter members of the group would be enabled to improve the gene pool through having children, as compared with the less successful and duller ones who would not be allowed to have children.

Here, too, it is difficult to ascertain the truth or otherwise of these historical and evolutionary factors, but no doubt future research will enable us to assess their validity along similar lines to those adopted by Richard Lynn in his argument. Regardless of the details, what is important is that he has put the whole discussion on a new level, suggesting that differences between ethnic groups in intelligence are much more complex, and have much more complex historical reasons, than had been considered before. Regardless of whether his suggestions are true or not (and they seem eminently reasonable), this fact alone makes this contribution an outstandingly important one in the annals of intelligence testing.

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# A Discussion of Richard Lynn's Evolutionary Theory on the Intelligence of Mongoloids

*Beverly Halstead*

Departments of Zoology and Geology, University of Reading, UK

Richard Lynn provides a signal service in discussing the differences in intelligence between Mongoloids and Caucasoids. For some reason this topic does not have the same emotive impact as any comparable scientific study of differences between other races, such as between Caucasoid and Negroid. Any discussion of this latter topic brings forth the ire of the radical left. This notwithstanding, there is no justification for attempting to prevent the basic acquisition of information on supposedly sensitive issues. In this light Lynn's discussion on the relative intelligence of the Mongoloids is particularly valuable as a prime example of ensuring such type of research does not get suppressed. The major conclusions are that the Mongoloids are characterized by high general intelligence, high visuospatial abilities and low verbal abilities in comparison with Caucasoids. Supposedly, if his results had revealed a different pattern that demonstrated the overall superiority of the Caucasoids, he would have had abuse heaped upon him.

Briefly then, Lynn considers racial differences from three standpoints: psychometric, evolutionary and neurological. From all the evidence Lynn assembles there seems no reason to doubt that, in general, Mongoloids do indeed on all types of appropriate measurements display a high general intelligence characterized by high visuospatial abilities and low verbal abilities. There seems also to be a suggestion of a slow maturation in infancy and early childhood.

Lynn concludes that this pattern does not seem to be environmental but seems to be substantially genetically programmed. He speculates on the evolutionary pressures of selection that favored the observed pattern and suggests the extreme cold of the ice age as a pressure for high general intelligence and visuospatial abilities. He also discusses the nature of the Mongoloid brain, suggesting that the visuospatial cortex is expanded at the expense of the verbal.

In my view, the studies on the Japanese, in particular, are difficult to

**BEVERLY HALSTEAD** holds a Ph.D. in vertebrate paleontology from University College, London, and a D.Sc. from the University of Sheffield, and has been a reader in geology and zoology at the University of Reading since 1968. He is secretary of the Geology Section of the British Association, vice president of the Palaeontological Association, and editor of *Modern Geology*. His books include *The Pattern of Vertebrate Evolution*, *Bare Bones — An Exploration in Art and Science*, *The Ecology and Evolution of the Dinosaurs*, *Hunting the Past*, and *Imanishi Shinkaron Hihan No Tabi*.

separate from a basic understanding of the nature of the educational system in Japan. Here again, Lynn (1987) is able to provide a valuable insight into the Japanese system and especially the motivation engendered for academic work. I have examined the series of science texts from infant through to senior schools and have been particularly impressed by the broad sweep of topics encompassed. All Japanese schoolchildren obtain an excellent grounding in earth sciences throughout their school life — something lacking in our own system so that this absence of awareness must cost the British billions of pounds in unnecessary waste of resources. The interesting fact is that Japanese are slow developers, being lower in general intelligence from $2^{1}/_{2}$ to $5^{1}/_{2}$, from 6 to 8 about the same, but from 9 to 16 above Caucasoid children. Sibatani (1982) has suggested that this may be a reflection of the intense competition in Japan.

The fact that the evidence of high visuospatial skills is also found in Eskimos does seem to confirm Lynn's thesis that this is a fundamental Mongoloid trait. The work of Tsunoda (1978) claiming that there was a fundamental difference between the brains of the Japanese and everyone else was taken up with great enthusiasm and achieved great popular acclaim in Japan. This should be understood in the more general context of Nihonjinrin, the "discussion of Japaneseness," the strange insistence of Japanese uniqueness in everything imaginable, so brilliantly and devastatingly dissected by Peter Dale (1986). The curious findings of Tsunoda link the Japanese and Polynesians with their particular abilities — but then the Koreans and Caucasoids will also show a Japanese pattern if their first language is Japanese. In contrast, third-generation Japanese in the United States and Brazil show typical non-Japanese responses.

There are claims that with Mongoloids logical thinking and emotional activities are not partitioned but are tucked into one and the same hemisphere of the brain: a powerful support for the Japanese notion of the inherent harmony of everything and especially the Japanese. This view is promoted with both vigor and elegance by Kinji Imanishi, but see my book on this subject (1987b), summarized in *Nature* (Halstead 1985,1987a), which discusses the unreality of this particular Japanese fantasy world.

One of the features not touched upon by Lynn, in either his paper on Japanese education or on his discussion on Mongoloid intelligence, is the matter of originality. This is the main thrust of Sibatani's (1984), to my mind chilling, account of the current Japanese trends, in what he terms a manipulated society. I described the situation as one of a feudal society masquerading as one of the world's great powers (Halstead, 1985).

In many ways the difference between the type of intelligence between Mongoloids and Caucasoids is comparable to the differences between male and female. The amount of difference is, however, greatly exaggerated between the races by some 8 points as opposed to a mere 2 points between the Caucasoid sexes.

Lynn suggested that the development of a new environmental niche in which survival demands greater intelligence is the key to understanding the particular characteristics of Mongolian intelligence. He relates the sexual differences to the importance of visuospatial abilities by the males in foraging and hunting and the female verbal abilities being a reflection of childrearing and education. It is well known that the racial features of the

Mongoloids are adaptations to life in a cold climate and Lynn attributes these to the ice age, the Devensian in particular, which in a sense trapped man in Asia in a hostile environment between the ice to the north and the mountain ice caps on the Himalayas to the south.

I would like to discuss this notion in some detail. From the work of Rosemary Powers (1988), who has collated all known representations of the human form during the Palaeolithic, from 30,000 to 10,000 years ago, it seems as if human beings were Caucasoid in their facial features. The earlier inhabitants of Western Europe, the Neanderthals, were certainly well adapted to life in a cold climate. They became extinct with the advent of Cro-Magnon man. Although we tend to think of the cold periods of the ice ages, which were present during the past two million years, as representing a hostile environment, this was not necessarily the case. Indeed, Kurten (1986) has insisted that this was a veritable golden age of mankind with abundant food, fire, warm clothing and plenty of leisure. Hence the flourishing of art and interest in sex.

The abundance of animal life was a direct result of the immensely rich so-called mammoth steppe with its astonishingly nutritious flora that supported vast herds of mammoths and much else besides. The end of the last glaciation saw the end of the mammoth steppe flora and the animals it supported. That was the real environmental crisis, with the extinction of many of the mammalian species that had provided man with his livelihood.

The evolution of modern races seems to be characteristic of the Flandrian or post-glacial epoch of the last 10,000 years, with more settled communities isolated in different geographical regions, the extremes being represented by tropical forests in Africa and the cold boreal realm in the Arctic. One could speculate that the nature of the Mongolian intelligence may indeed be a consequence of adaptation to life in harsh arctic climes, in effect, in a marginal environment. Group hunting as opposed to individual enterprise would have had a high survival value and in a modern world the economic success of the Mongoloids is dramatic evidence of the power of the corporations. But at the end of the day originality and creativity rely on freedom of action of the individual. The significance of Imanishi in Japanese culture is his originality and individuality, in spite of his protestations to the contrary. Whereas the feudal nature of Japanese society extols the value of the group, nonetheless there is a recognition, even in Japan, of the need for individuals to have the mental freedom to explore. In this case, it is a privileged elite, the Kyoto Elite, that, certainly in the sciences, manages to collect all the Nobel Prizes, to the chagrin of the powerhouse of Tokyo. This is not a coincidence.

Which leaves me finally to wonder if many of the differences enumerated by Lynn may not after all have been engendered by centuries of surviving in a conformist, manipulative society.

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# More Evidence Needed on the Intelligence of Other Mongoloid Peoples

*Takeshi Hatta*

Osaka University of Education, Japan

Based upon the precise examination of intelligence test results, Dr. Lynn proposed a model of intelligence in which he specially stressed the differences in brain function between Mongoloids and Caucasoids. His model, in short, consisted of three points: 1) the Mongoloids are superior to the Caucasoids in Spearman's g factor, 2) the Mongoloids are superior to the Caucasoids with regard to the visuospatial factor while the Caucasoids are superior to the Mongoloids for the verbal factor, and 3) the Mongoloids' intelligence development is slower in infancy and early childhood than Caucasoids'.

Dr. Lynn aimed to show the appropriateness of his proposal by the comparison of the data of various intelligence tests which were conducted in different countries. And he offered a model which aimed to interpret why the differences exist between the results of Mongoloids' and Caucasoids' intelligence tests. He rejected an environmental interpretation and preferred a genetic one. His genetic view is in many respects persuasive. He presents an evolutionary view of brain development from Australopithecus to modern Mongoloids and Caucasoids. His genetic view seems to rely on a recent "resource model" in information processing theory. That is, resources of the human brain have a limited capacity and when one hemisphere consumes the resource, the other hemisphere is affected and suffers reduced capacity. A similar view has been advanced by Liederman (1986). More concretely, he proposes that in the course of human evolution, the Mongoloids have consumed the left hemisphere (verbal ability) resource more than the right hemisphere resource and therefore they possess superior visuospatial ability and poor verbal ability. On the other hand, the Caucasoids have consumed the right hemisphere resource more than the left hemisphere; hence their verbal ability is high but their visuospatial ability is low.

This genetic model seems to me reasonable in general because first he offered the psychometric evidence to support the theory, i.e., the negative correlation between verbal and spatial IQs, and second, I like this kind of speculative theory which stimulates researchers' scientific imaginations and generates many predictions for further investigation. It seems to be

**TAKESHI HATTA** graduated from Osaka City University in 1968 and the university's graduate school in 1974. Since 1977 he has taught at Osaka University of Education, where he received his doctoral degree in 1981.

fair to add at present the words "in general" because of several questions and problems.

As Dr. Lynn cited our cross-cultural experiment (Hatta and Dimond, 1980) where we showed some laterality differences in visual function between Japanese and British students, it is my task to refer to new materials which have some relevance to his model. We found that the British students perceived visual shapes with equal accuracy in both visual fields. Both British and Japanese subjects perceived the verbal materials in a similar way, i.e., they had right visual field superiority. Dr. Lynn interpreted the findings that the Japanese students have superior visuospatial abilities in both hemispheres while the British processed the stimuli only with the right hemisphere. More concretely, the finding supports his model that the Mongoloids possess superior visuospatial intelligence than the Caucasoids. It is proper to state that our findings do not necessarily fully support his model, because our experiment did not find the British students' superiority in verbal material recognition compared to the Japanese students'.

In our recent studies (Hatta, 1985; 1986; Hatta and Ikeda, 1987; Hatta, Hirose, Ikeda, and Fukuhara, 1987), abacus experts and control subjects were asked to remember auditorily presented digit sequences for 15 seconds and during this retention period pictures of abacus figures or digit sequences were presented. The abacus experts were more disturbed by the presentation of abacus figures but the controls were disturbed more by the presentation of digits. This result shows that abacus experts can visualize a mental image of abacus to improve memory retention. Hatta (1986) and Hatta and Ikeda (1987) demonstrated that the abacus experts employed the right hemisphere but the controls employed the left hemisphere in mental calculations using a time-sharing task.

When abacus experts were given a mental calculation task (or a news listening, word reading task) and finger tapping task simultaneously, the abacus experts showed greater interference effects with their left hand but the controls showed greater interference effects with their right hand in calculation. In news listening and word reading tasks, both groups showed greater interference effects with their right hands.

The experiment also showed that after about two or three years of training, the abacus trainees aged 8 to 10 years old come to possess similar hemisphere functions (i.e., the right hemisphere in calculation). It may give some support to Dr. Lynn's model if we can show that the Mongoloids can easily develop the right hemisphere involvement pattern by training but the Caucasoids have difficulty in this training. As I have heard that abacus training is now in use among American children in California, we may be able to seek relevant data.

As I have said, Dr. Lynn's model of the Mongoloids' intelligence seems to be reasonable and I agree that the theories which he advanced in the article are persuasive. Nevertheless, there are some problems which require further investigation. First, Dr. Lynn used mean IQs from intelligence tests to support his model. However, when the mean IQs of the spatial factor are higher in Mongoloids than in Caucasoids, it does not necessarily show that more Mongoloids show such a tendency than Caucasoids. To establish this, non-parametric examination in addition to parametric examination is required.

Second, the idea of trade-off in brain evolution was confirmed by the presentation of negative correlations between verbal and visuospatial IQs. However, the confirmation was calculated without any consideration of sex differences. Based upon the trade-off model, the continuum of the Caucasoid female-Mongoloid female-Caucasoid male-Mongoloid male, where the one extreme shows high verbal-low visuospatial intelligence, can be considered. Therefore, the evidence which shows 1) the negative correlation is high in male Mongoloids and female Caucasoids, and 2) low negative or no correlation in female Mongoloids and male Caucasoids, should be collected by further calculation.

Third and finally, the size of the samples is not particularly large, and the effort to collect more data is indispensable. Especially, not only data from the Mongoloids in Japan but also from Mongoloids in Taiwan, Singapore and China should be collected for further tests of the model.

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# Environmental Conditions During the Würm Glaciation in Asia and Europe

*Kanetoshi Hattori*

National Rehabilitation Center for the Disabled, Tokorozawa City, Japan

I would have some doubts as to whether the climatic differences between Europe and Northeast Asia during the last Würm glaciation were sufficient to explain the evolution of different patterns of abilities in Caucasoids and Mongoloids. The large ice sheet in Scandinavia and on the Alps produced tundra in Europe, while Northeast Asia was largely steppe (Suzuki, 1975). During this period the Mongoloid peoples appear to have been nomadic during the summer and principally hunted large animals, particularly mammoth. During the winter they often lived in dugouts or other shelters as protection against the cold. Dr. Lynn is correct to say that these peoples lived by hunting. But there are doubts as to whether fine perceptual discriminations were required to detect what are described as "slight variations in a relatively featureless array, such as the movement of a white Arctic hare against a background of snow and ice." Mammoths and other large game animals were easily detectable, but it may be correct that visuospatial abilities were used to hunt and trap them.

So far as Mongoloid/Caucasoid differences in intelligence are concerned, there is a need for further work to check whether the factor structure of abilities is the same in the two populations. There may also be developmental differences in the cognitive strategies adopted by children in tackling tests in different cultures. We have recently demonstrated a developmental shift of strategies among Japanese children taking the Columbia Mental Maturity Scale (Hattori, Fujita and Obata, 1987). These differences in strategy may be culturally determined. In general I would advocate a close consideration of the possible role of cultural factors as determinants of Mongoloid/Caucasoid differences in abilities.

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**KANETOSHI HATTORI** graduated in psychology from Yokohama City University in 1971 and received his M.Ed. degree from Auburn University in 1978. Since then he has worked at the National Rehabilitation Center for the Disabled in Tokorozawa City. He was involved in the standardization of the Columbia Mental Maturity Test in Japan and has done further work on the mental abilities of Japanese children.

# Mongoloid Mental Ability: Evolution or Culture?

*Arthur R. Jensen*

University of California, Berkeley

Professor Lynn's provocative paper has two main aspects. The first is his review of the available psychometric facts regarding the mental abilities of the Mongoloid populations in comparison with other populations. The second is his theoretical interpretation of the nature and origin of the empirically observed population differences.

The first aspect impresses me as a thorough and accurate account of the empirical evidence. The facts themselves are virtually noncontroversial, although students of this topic may argue about the population sampling and statistical methods used in estimating the size of the psychometric differences, or the cross-cultural validity of the tests, or the accuracy of the adjustments in standardized test scores required to take account of their apparent secular rise over the time period for which comparative data are available. But the general consistency of the many lines of evidence, from Asia and North America, makes these technical questions hardly more than minor issues as compared with the daring evolutionary interpretation by which Professor Lynn tries to comprehend the evidence. It will be viewed as highly speculative and controversial by most behavioral scientists, and as wholly unacceptable by those who habitually resist any suggestion of genetic differences between racial populations in behavioral traits, especially mental abilities.

Professor Lynn proposes an evolutionary, essentially Darwinian, explanation of the origin of the Mongoloid advantage in psychometric g (the general ability factor that accounts for positive correlation among diverse tests of mental abilities) and the distinctive pattern of higher spatial ability than verbal ability, as compared with Caucasoid and Negroid populations. Evolutionary divergence of populations, of course, depends on genetic selection and necessarily implies a genetic component in the differences observed between contemporary populations. No scientists today argue about the evolutionary and genetic basis of the great variation among racial populations in many physical characteristics. And there is no scientifically justifiable *a priori* reason for taking a different position regarding behavioral characteristics, especially those traits, such as g and spatial and verbal abilities, for which there is already overwhelming evidence for the substantial heritability of individual differences within major populations.

**ARTHUR R. JENSEN** majored in psychology at the University of California at Berkeley and took his Ph.D. degree at Columbia University. Since 1965 he has been professor of educational psychology at UC/Berkeley, where his work has been largely in the field of intelligence. His latest book is *Bias in Mental Testing*.

The fact that within racial populations mental abilities have been proven to be heritable (that is, involve genetic factors) does not by itself constitute proof that the observed differences between populations also involve genetic factors. But it lends plausibility to the notion of evolutionary divergence in abilities, as suggested by Professor Lynn, because the genetic basis by which the incremental effects of natural selection are transmitted across generations in the course of evolution definitely exists in the case of mental ability. There is evidence that the heritability of psychometric g is greater than the heritability of any other mental ability. It is also of interest that in the whole domain of abilities it is the g factor that most markedly differentiates racial populations.

Professor Lynn's evolutionary conjectures are plausible and would raise few eyebrows if they involved only physical rather than mental traits. For a speculative theory to go beyond mere plausibility to something that constitutes "proof" in the conventional scientific sense, however, is a big order. It may even be impossible in the foreseeable future, as it would depend first of all on establishing that the ability differences between the Mongoloid and other populations involve genetic factors. Aside from a true genetic experiment, which would require the cross-breeding of large random samples of different racial groups and the cross-fostering of the offspring, and therefore would be wholly unfeasible and ethically unacceptable, there is no single item of evidence that could test this hypothesis. In such a case, investigators must assemble various items of evidence, no one of which is conclusive, but which are all consistent with the proposed theory and for which *in toto* the theory provides a more comprehensive and compelling interpretation than does any competing theory.

For example, it has already been found that Mongoloid neonates differ behaviorally from Caucasoid and Negroid neonates, even in the first few days after birth, before any cultural conditioning could have occurred. Are such neonatal differences in reactivity to stimuli and in motor coordination related to g at a later age within each population? If so, it would increase the plausibility that population differences in g have a biological component. Myopia (nearsightedness) has a well established correlation with IQ, and we have recently shown that the correlation exists within families: that is, the brighter sibling is more likely to be myopic. Academically gifted children, for example, are more myopic than their less gifted siblings. Since myopia in the vast majority of cases cannot be accounted for by environmental effects, its within-family correlations with IQ suggests a genetic pleiotropism: that is, two distinct traits influenced by a single gene (or set of genes). Mongoloid populations are significantly more myopic than any other major racial groups; Negroid populations are the least myopic, and Caucasoid populations are intermediate, except for Jews, who are closer to Mongoloids in the incidence of myopia. Other pleiotropic correlations between various physical characteristics and mental abilities that can be found to exist within a given racial population should be looked at with respect to correlated differences between various racial populations.

A number of such apparently pleiotropic correlations that exist both within and between racial populations, as in the example of myopia and IQ, would be quite understandable in terms of genetics and evolution, but could not be comprehended by any theory that invoked exclusively cultural factors as the cause of the observed differences in mental abilities between various populations. Exclusively cultural theories posit a one-way direction of causality between culture and mental ability, and ignore the likelihood that certain cultural differences may be, to some degree, the product of the genetically transmitted effects of natural selection and the resultant divergence of racial populations in the course of human evolution. Professor Lynn fortunately has not made this elementary error in his attempts to understand the differences between the Mongoloid and other populations in psychometric abilities, with their many important educational, social, economic, and cultural correlates.

# Differences and Similarities in Cognitive Abilities Between Caucasian and Japanese Subjects in Hawaii

*Craig T. Nagoshi*

Institute for Behavioral Genetics, University of Colorado, Boulder

Dr. Lynn must be commended not only for compiling the empirical evidence in support of the existence of consistent Caucasoid/Mongoloid differences in the overall level and patterning of cognitive abilities, but also for thinking through and presenting some insightful speculations on the evolutionary and neurological bases of these differences. His empirical findings are highly consonant with those we obtained (described below) with a large sample of Caucasian and Japanese subjects in Hawaii. Our interpretations of our own findings lead to many of the same conclusions as Dr. Lynn's.

Before proceeding, an important caveat should be noted. The concern here is an understanding of the bases for mean differences between racial/ethnic groups in cognitive abilities at any one time. It must be remembered that individual differences within groups are considerably greater than the between-groups differences. As will be further elaborated below, mean cognitive test performances are rapidly changing over time. The bases for within-group variability and secular changes in cognitive abilities may not be the same factors that determine between-groups differences.

The large secular increase in the past 50 years in mean intelligence test scores in the United States, Western Europe, and Japan has now been noted by several authors (Flynn, 1987; Lynn and Hampson, 1986; Teasdale and Owen, 1987) and was a factor that Dr. Lynn had to take into account in doing comparisons across cognitive abilities measures normed at different times in different nations. This secular change was undoubtedly the result of environmental factors, the most likely being national changes in the availability and quality of public education. This historical transformation, without an associated increase in "real" national achievement, causes Flynn (1987) to question the validity of standardized IQ tests. With regard to national comparisons of mean abilities test scores, this change might cause further skepticism in those who already question the metric

**CRAIG NAGOSHI** has recently accepted a position as a staff fellow at the National Institute on Drug Abuse Addiction Research Center in Baltimore. He received his Ph.D. degree in psychology from the University of Hawaii at Manoa in 1984 and did three years of postdoctoral work at the Institute for Behavioral Genetics at the University of Colorado at Boulder. He is the author or co-author of more than 30 articles on genetic and environmental influences on individual differences in cognitive abilities, personality, alcohol use and abuse, and responses to alcohol.

equivalence of measures normed at different times in different nations, where language and cultural differences render some tests untranslatable.

Data from the Hawaii Family Study of Cognition (HFSC; further described in DeFries et al., 1979, and Wilson et al., 1975) can provide powerful tests for some of Dr. Lynn's hypotheses. The HFSC involved the testing of 1,816 families (both biological parents and at least one offspring 13 years of age or older; 6,581 individuals) on a diverse battery of 15 cognitive abilities tests. There were 926 families in which both parents were Americans of European ancestry (AEA) and 368 families where both parents were Americans of Japanese ancestry. Although these families were not representative of the population in Hawaii, differences in selection biases should not have been great between the two racial/ethnic groups.

Several features of the HFSC sample, design and findings are noteworthy here. Nearly all of the AEA parents and their parents (the grandparent generation) were born and raised in Hawaii or the mainland United States. Nearly all of the AJA parents were born in Hawaii and grew up in an American cultural setting, but their parents were nearly all from Japan, spoke Japanese in the home, and were of considerably lower educational and occupational status than the corresponding AEA grandparent generation (Johnson et al., 1983). AEA and AJA parents, however, were of comparable educational and occupational attainment, reflecting substantial social mobility for the AJA parents. Hence, their children (the offspring generation) grew up in similar American environments and themselves later attained comparable levels of social success (Nagoshi et al., 1986). The AEA and AJA families thus brought into the study considerably different environmental as well as genetic backgrounds, but having all grown up in a basically American society and having been educated in American school systems, there could be much less doubt regarding the cross-cultural equivalence of the HFSC measures than would be the case for comparisons of different nations.

As reported in DeFries et al. (1982) and Nagoshi and Johnson (1985), AEA-AJA comparisons of mean cognitive abilities scores are confounded by significant cohort and maturational effects. AEA offspring scored the same or slightly lower than their parents on the HFSC cognitive test battery and the Wechsler Adult Intelligence Scales (administered to a subsample of families), probably reflective of their not having reached the age of maximum test performance. In contrast, AJA offspring scored considerably higher than their parents on these abilities measures, probably reflecting the powerful effects of acculturation on this group. All generational comparisons are also confounded by the secular increase in IQ scores noted above.

Given these environmentally mediated AEA-AJA mean differences in cognitive abilities, it may be surprising to some that the factor structures for the 15-test HFSC battery (the loadings on the unrotated first principal component, a measure of g or general intelligence, as well as the Varimax-rotated four-factor structure) were virtually identical for AEA and AJA subjects (as well as across sexes and generations; DeFries et al., 1979; Nagoshi et al., 1984; Wilson et al., 1975). Confirmatory factor analyses of a hierarchical cognitive abilities factor structure were also conducted on between-pair means versus within-pair differences in abilities scores for

370 HFSC AEA sibling pairs and 116 HFSC AJA sibling pairs (Nagoshi et al., in press). These analyses indicated that the between- and within-pair structures were not significantly different, which in turn suggested that the relationships among the various tests were due to "intrinsic" determinants which operate both within and between families, such as genetic pleiotropy, and not "extrinsic" determinants which only have effects between families, such as socioeconomic status (Jensen, 1980). Of interest here, there were also no significant differences between AEA and AJA siblings on either between- or within-pair structures.

We have recently had published the results of our comparisons of AEA and AJA cognitive profiles (Nagoshi and Johnson, 1987). These analyses were conducted a year ago and are highly consistent with Dr. Lynn's conclusions that Caucasians score higher than Japanese on verbal abilities but lower on spatial abilities tests. These racial/ethnic differences remained constant across sexes and generations (parents versus offspring) in spite of the mean generational changes noted above and the well known sex differences normally found for tests of verbal and spatial abilities. It should also be remembered that these results for Hawaiian-born AEA and AJA subjects are consistent with comparisons reported by Dr. Lynn between Japanese born and educated in Japan versus Americans and Europeans born and raised in the United States and Europe.

Given the background of significant environmental effects on mean cognitive abilities among AEA and AJA subjects in the HFSC, the findings of consistent factor structure similarities and consistent cognitive profile differences between AEA and AJA subjects suggest that these are mediated by genetic factors. As Dr. Lynn points out, it is not enough to say that a phenotype is genetically determined. One must then consider the evolutionary significance of the phenotype and the physiological mechanisms that underlie it. Much of what he proposes in the later sections of his paper is admittedly speculative but serves to provoke thought and generate testable hypotheses.

Several cultural aspects of Hawaii make it an ideal location to test these findings. Dr. Lynn cites the work of Stevenson et al. (1986) as an argument against Caucasian versus Japanese differences in childrearing and educational practices as the bases for differences in cognitive abilities between the two groups. AEA versus AJA comparisons of childrearing practices in Hawaii would be less confounded by language and extraneous cultural differences. The high rate of cross-ethnic mating in Hawaii provides a large pool of subjects of mixed Caucasian-Mongoloid ancestry that may provide insights into the genetic and/or environmental factors underlying the unmixed group differences. All of these investigations and speculations, in turn, cannot help but provide us with a better understanding of the nature and social significance of "intelligence."

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# Mongoloids, Caucasoids and Negroids in Evolutionary Perspective: A Commentary on Lynn

*J. Philippe Rushton*

Department of Psychology, University of Western Ontario, London, Ontario,
Canada

Lynn has provided extensive scholarly documentation that in both general IQ and visuospatial abilities, Mongoloids score higher than Caucasoids. Moreover, he judiciously theorizes about the evolutionary and neurological origins of this superiority as well as reviewing other correlates including sex hormones and developmental delay. In a recent overview of mathematics education, Steen (1987) provided additional data that supports Lynn's thesis, showing that within the United States, the proportion of Oriental-American students who achieve high mathematics scores (above 650) on the Scholastic Aptitude Test is twice the national average, while the proportion of Black students is less than one-fourth the national average. Here I review multifarious other racial differences that accord with an evolutionary ordering of Mongoloids > Caucasoids > Negroids, and outline a theory of r/K reproductive strategies which might account for them.

The pattern noted by Lynn, in which Caucasoids fall *between* Mongoloids and Negroids, also occurs on estimates made of brain size, personality and temperament, rate of maturation, sexual restraint, and social organization (Rushton, 1985a, in press; Rushton and Bogaert, 1987). With respect to brain size, for example, Coon (1982) calculated cranial capacity from observations recorded by Howells (1973) of 2,000 skulls from 17 populations gathered on a tour of the world's museums. I averaged these figures and found: Mongoloids, 1401cc; Caucasoids, 1381cc; and Negroids, 1321cc (Rushton, in press). Other data show similar results. Thus, in a widely cited highly critical review, Gould (1978) reanalyzed 19th-century data on skull size purportedly finding evidence of "unconscious

**JOHN PHILIPPE RUSHTON** is professor of psychology at the University of Western Ontario in London, Canada, and is a Fellow of the American, British, and Canadian Psychological Associations. He received his B. Sc. degree in 1970 and his Ph.D. degree in 1973 from the University of London in England, after which he spent a year at Oxford University researching personality development in children; since then he has been teaching in Canada. Professor Rushton's research encompasses developmental, personality and social psychology, particularly the processes involved in altruistic behavior. He has contributed five books and more than 80 articles and book chapters to the scientific literature. Over the last few years, Dr. Rushton has been exploring human behavior from an evolutionary perspective.

bias" and "rounding errors." Nonetheless, Gould's own "corrected" estimates of these data show the rank ordering to be Mongoloids > Caucasoids > Negroids with cranial capacity in cubic inches = 85.5, 84.5, and 83, respectively. The same relationships are found in brain weight measured at autopsy in which I calculated average estimates of 1351gms, 1336gms, and 1286gms, respectively. These differences would be larger if adjustments were made for the brain-body allometric regression because Mongoloids are typically smaller in body size than Caucasoids. Also, there is evidence that in Caucasoid samples brain weight begins to decrease around age 25, whereas in Mongoloid samples the decrease doesn't begin until age 35 (Ho, Roesmann, Straumfjord and Monroe, 1980).

The data on "sexual restraint" shows a similar rank ordering on numerous indices including gamete production (dizygotic birthing frequency per thousand: Mongoloids < 4; Caucasoids = 8; Negroids > 16), intercourse frequencies (premarital, marital, extramarital), precocity (age at first intercourse, age at first pregnancy, number of pregnancies), primary sexual characteristics (size of penis, vagina, testes, ovaries), secondary sexual characteristics (salient voice, muscularity, buttocks, breasts), and biologic control of behavior (periodicity of sexual response, predictability of life history from onset of puberty), as well as with androgen levels, sexual attitudes, and sexually transmitted diseases (Rushton and Bogaert, 1987).

Similar findings occur with temperament and personality. Across ages (24-hour-old infants, children, high school students, university students, and adults), across traits (activity level, aggressiveness, cautiousness, dominance, excitability, impulsiveness, and sociability), and across methods (archival statistics, naturalistic observation, ratings and self-reports), much data support the hypothesis that, in terms of behavioral restraint, Mongoloids > Caucasoids > Negroids (Freedman, 1979; Vernon, 1982). For example, Rushton (1985b) indexed behavioral restraint by low extraversion (sociability) and high neuroticism (anxiety) scores from the Eysenck Personality Questionnaire and, aggregating data collected from 25 countries, found that eight Mongoloid samples (N = 4,044) were less sociable and more anxious than 38 Caucasoid samples (N = 19,807), who were less sociable and more anxious than four African samples (N = 1,906). Moreover, the same pattern of racial differences is observed with maturation rate (age to walk alone, age of puberty, age of death) and social organization (marital stability, mental health, law abidingness).

That across populations brain size negatively correlates with gamete production and both co-vary with a suite of other attributes suggests underlying differences in r/K reproductive strategies where a trade-off is postulated to occur between egg production and parental care (Rushton, 1985 a; following Wilson, 1975). As shown in Figure 1, oysters, producing 500 million eggs a year but providing no care, exemplify r, while great apes, producing one infant every five or six years and providing lavish care, exemplify K. Animal studies show these reproductive strategies correlate with other features of the organism's life history, including: litter size, birth spacing, infant mortality, maturation speed, life span, energy use, encephalization, dispersal tendency, population size, social organization, and altruism. All the data converge to the effect that, in terms of K, Mongoloids > Caucasoids > Negroids.

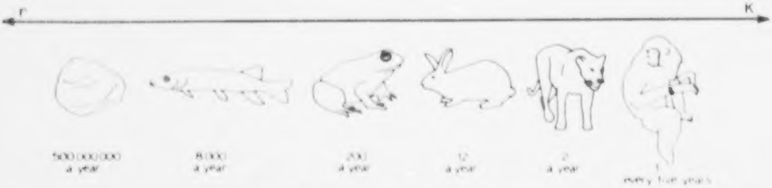

**Figure 1.** The r/K continuum of reproductive strategies balancing egg production and parental care (After Johanson & Edey, 1981).

The question arises as to whether, in some sense or another, one race has evolved more. Lynn's essay suggests the answer may be "yes," and I agree. Although it has become unfashionable to view man as the most "advanced" of species, this once traditional view gains novel support from the perspective of the r/K dimension. As Wilson (1975) put it, "In general, higher forms of social evolution should be favored by K selection" (p. 101). The process may have carried some individuals and populations further than others.

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# Brain Structure in Mongoloids and Caucasoids

*Daniel R. Vining, Jr.*

Regional Science Department, University of Pennsylvania

Richard Lynn has written a very interesting paper. Evidence up to now is psychometric, but Lynn claims that the neurological structures of the Mongoloid's brain are different from those of other races. We need to test this hypothesis.

The hypothesis is that the Mongoloids' higher scores on visuospatial tests are due to the fact that some portion of the left cerebral hemisphere of the Mongoloids is reserved for visuospatial activities, while in other races there is no such portion. What we need to find out is whether this is true or not. If it is true, we have more than just an interesting paper. If it is not true, then we have a very interesting review paper of the psychometric evidence on the higher mental abilities of the Mongoloids, although the mystery of their higher intelligence is still present.

We need a good review paper; but if there is something different also about the Mongoloid's brain, then we have something truly revolutionary. I await physical testing of the neurological hypothesis.

**DANIEL R. VINING, JR.**, a native of Fayetteville, Ark., received his B.S. degree from Yale University in 1966, his M.P.A. degree from Princeton in 1971, and his Ph.D. degree from Carnegie Mellon University in 1975. A veteran of the U.S. Marine Corps, he spent two years in Viet Nam and one year in Japan. He has taught at the University of Pennsylvania, where he is assistant professor, since 1980.

# Some Further Observations on the Intelligence of the Mongoloid Peoples

*Richard Lynn*

University of Ulster, Coleraine, Northern Ireland

I am grateful for all the commentators who have raised many interesting questions, cited new data and, in some cases, expressed reservations about some of my hypotheses on the evolution and neurological basis of the intelligence of the Mongoloid peoples. I appreciate the many thoughtful and useful observations which the commentators have made.

Dr. Arthur Jensen has rightly said that it is difficult to rule out conclusively the operation of cultural factors as determinants of racial differences in intelligence. It is, as he says, necessary to look at the totality of the evidence and make a judgment as to whether environmental or genetic explanations, or some mixture of both, are more reasonable.

One approach to this question is to consider whether a particular race has the same characteristic intelligence and pattern of abilities in a variety of different cultural environments. If it does, it suggests that some genetic programming is present and comes through irrespective of local environmental conditions. It is for this reason that I have attempted to widen the debate from evidence on race differences within the United States to which, as Professor Hans Eysenck says, it has been largely confined, and examine the data more globally. My general conclusions were that Mongoloids everywhere tend to have high general intelligence and strong visuospatial abilities. One of the most important contributions in this area is Dr. Craig Nagoshi's contribution of his new evidence that ethnic Japanese in Hawaii (Americans of Japanese ancestry) have exactly the same strong visuospatial-weak verbal pattern of abilities as we have found among the Japanese in Japan. The ethnic Japanese in Hawaii have been brought up in an English-speaking and -writing American culture. Environmental theory would surely predict that this pattern of abilities would have been molded by that culture and would be indistinguishable from that of Caucasian Americans.

Genetic theory predicts that the Mongoloid pattern will be retained. It seems clear that genetic theory has greater explanatory and predictive power for the appearance of the Mongoloid abilities pattern among this

**RICHARD LYNN** was educated at Bristol Grammar School and the University of Cambridge, from which he received his M.A. and Ph.D. degrees in psychology. He has served as lecturer in psychology at Exeter University, research fellow at the Neuro-Psychiatric Research Institute in Princeton, professor of psychology at the Dublin Economic and Social Research Institute, and since 1972 has been professor of psychology at the University of Ulster. His latest book is *Educational Achievement in Japan* (1988).

population. More studies of other Mongoloid populations are needed and certainly Dr. Takeshi Hatta is correct in calling for the need for further studies, particularly of the Chinese, to determine whether the theory has predictive power for these.

Dr. J. P. Rushton develops further the idea that there is a gradient of evolutionary development running from Negroids to Caucasoids to Mongoloids. The evidence he has collected to support the view that the brain has evolved to larger dimensions in Caucasoids and has retained its greatest size in Mongoloids adds an important new strand of evidence to the question of racial differences in intelligence. It has been shown that brain size is related to intelligence (Van Valen, 1974). Dr. Rushton's evidence on this question presents a major challenge to those who maintain that there are no differences in intelligence between the races.

Dr. Rushton also proposes that other traits besides intelligence have evolved differentially in different races and have reached their highest development in the Mongoloids. It seems entirely probable that the harsh environmental conditions in which the Mongoloids have had to survive would have led to the further evolution of a number of noncognitive traits. In this connection, Dr. Beverly Halstead makes the interesting and plausible suggestion that the reliance of the Mongoloids on group hunting could have acted as a selection pressure for group co-operation and conformity and that this could be the basis for the high level of group co-operation and identification which is such a striking feature of contemporary Japan.

Professor Eysenck makes the useful point that Caucasoid populations do not all have identical IQs. There are undoubtedly significant differences in intelligence between Caucasoid subpopulations and there are several factors which have operated at different times to bring these differences about. One of these is selective migration, and he instances Scotland and Ireland, which have probably suffered in this regard since the mean IQs in both these countries are a little below the Caucasian average (Lynn, 1979). Another probable case is that of Blacks in the midwestern and northern states of the United States, whose mean IQ is around 90, as compared to the southern states where mean IQ can be as low as 70 (Flynn, 1980). There is direct evidence from studies of migration that those who migrated north have tended to have greater intelligence than those who remained in the South (Shuey, 1966).

Professor Eysenck makes some interesting observations on the high intelligence of the Jews. There is little doubt that the mean IQ of the Jews is significantly higher than that of other Caucasian populations and that this has been a major factor in the great contributions that Jews have made to the world's intellectual achievements. The thesis that the high Jewish intelligence can be attributed to the two factors of the selection pressure exerted by persecution and the fertility of the rabbis is entirely plausible. A curious feature of the intelligence of the Jews is their high verbal abilities and their less good spatial abilities (Lesser, Fifer and Clark, 1965). It may be that rabbis were strong on verbal intelligence and that their high fertility has made some contribution to this pattern of abilities. The high intelligence of the Jews is a subject that deserves further research.

Several contributors expressed doubts about some of the hypotheses. A number of these were aired by Dr. Christopher Brand and I do not have the

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space to discuss all of them. He is, of course, right that there are problems in measuring the verbal abilities in different cultures, but I do not think these are insuperable. The extent of the vocabulary of young children can be tested by asking them to identify common objects such as parts of their own body. Immediate verbal memory for numbers can be measured with reasonable comparability, and so, too, can arithmetical ability.

Dr. Brand raises the interesting question of the Bushmen and the Australian aborigines. Early studies on these were done by Stanley Porteus using his maze test and he found them quite low for general intelligence. Subsequent studies have confirmed this conclusion for the aborigines. Neither of these peoples have ever been exposed to the severe cold that the Mongoloids and Caucasoids had to endure, since the climates in neither Australia nor Africa were much affected by the Ice Ages (Kirk and Thorne, 1976). I would therefore regard the evidence on the low general intelligence of these two groups as giving broad support to the thesis that prolonged exposure to cold was the crucial selection pressure responsible for the evolution of high intelligence in the Mongoloids and, to a lesser extent, in the Caucasoids. I doubt if there is any good evidence on the balance between the verbal and visuospatial abilities in these peoples.

Dr. Brand also takes up Dr. Rushton's argument that various personality traits seem to differentiate the Mongoloids from the Caucasoids. It is well established that a number of personality traits within Caucasian populations have a genetic basis and it does not seem improbable that these may have evolved differentially in different racial groups as adaptations to their unique environments.

Dr. Kanetoshi Hattori raises the question of whether the climatic conditions in northeast Asia were significantly more severe than those in Europe during the Ice Ages and therefore capable of explaining the evolution of high Mongoloid general intelligence and visuospatial abilities. He suggests that during the main Würm glaciation there were broadly similar cold climatic conditions in northeast Asia and in Europe.

This is correct. However, the main Würm glaciation was only the last of several periods of extreme cold to which the Mongoloid peoples were exposed. The main Würm glaciation lasted from approximately 24,000-10,000 YBP (Years Before Present). The proto-Mongoloid peoples were established in northeast Asia approximately 500,000 years ago. The best known site consists of the caves of Choukoutien some 40 miles from Peking (Liu, 1985). During the last 500,000 years the Mongoloid peoples were exposed to four principal cold periods, namely the Mindel (approximately 500,000-400,000 YBP), the Riss (approximately 240,000-210,000 YBP), the early Würm (approximately 70,000-40,000 YBP) and the main Würm (approximately 24,000-10,000 YBP). During this long period the Mongoloid peoples evolved from their distinctive morphological adaptations to cold.

None of the other races of Homo Sapiens has been exposed to the same degree of cold over such a long period. The living European Caucasoids are descended from the Cro-Magnons, who migrated into Europe from the Near and Middle East about 40,000 years ago (Pearson, 1974). They probably came from the Near East in the region of Israel. Whatever their precise origin, it was climatically benign because they had not evolved morphological adaptations to cold (Trinkaus, 1986). Once they were established in Europe they had to survive the main Würm glaciation (24,000-10,000 YBP), but they had to endure only some 14,000 years of these extremely cold and inhospitable conditions as compared with the successive glaciations to which the Mongoloid peoples were exposed over the last 500,000 years. The relatively short period of exposure to cold of the Caucasoid peoples explains why they did not evolve the same morphological adaptations as the Mongoloid peoples nor, according to my thesis, quite the same high general intelligence or visuospatial abilities that are necessary for survival in a very cold environment.

For something like half a century the question of race differences in intelligence has been largely concerned with the collection of data on IQs. There has been very little attempt to formulate theories as to how the observed differences may have arisen during evolution or as to the different brain structures that have evolved. Scientific understanding is advanced by both the collection of data and the formulation of theory, and I felt it was time to attempt some theoretical formulations in the field. Several commentators called for more work to test the theories and suggested useful ways in which this could be done. Dr. Daniel Vining and Dr. Takeshi Hatta call for further testing of the hypotheses concerning the unique brain structures that may have evolved in the Mongoloids, and Dr. Ian Deary draws attention to the recent development of brain scanning techniques by which this could be done.

It is now some 18 months since I wrote the paper which is the subject of the present commentary. In the ensuing period I have read the *Travels of Marco Polo*. This Italian gentleman travelled to Peking in 1275 and spent the next 20 years at the court of Kublai Khan. He then returned to Venice and wrote an account of his experiences. He describes the remarkably high level of civilization of this extensive Chinese empire which extended from the Pacific Ocean to the Danube. It included the sophisticated concept of paper money, which must surely have required an intelligent population to understand, accept and operate. In fact, Marco Polo expressed the opinion that "The Chinese are the wisest people in the world." This may be the first recorded observation of the high intelligence of the Mongoloids.

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# Mensa Education and Research Foundation: What Is It? And Why Is It?

*More and larger scholarships. More support for our gifted children programs. More support for research into the nature and uses of intelligence. More frequent colloquia. . .*

These goals are a recurring theme in surveys, local group newsletters, and conversations with Mensa members across the country. All evidence a desire for Mensa to be more than just a social organization—for Mensa to really contribute to the improvement of the society in which we live. In fact, many members joined Mensa expecting to participate in such activities.

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Essentially, MERF is a philanthropic, non-profit, tax-exempt organization whose purpose is to encourage research in the nature, characteristics and uses of intelligence.

Programs of MERF are funded primarily by tax-deductible gifts from members and friends of Mensa who are concerned with helping MERF continue its important work.

MERF's Scholarship Committee currently awards $28,000 annually in scholarships to 67 students nationwide. More than 5,000 students apply for the awards, which range from $200 to $1,000, and which are awarded solely on the basis of a competitive essay. Applicants must be enrolled in degree-granting programs at accredited American colleges and universities. Scholarship awards are not limited to Mensa members.

Several awards each year are made from endowed funds. These include the nine Grosswirth-Salny Scholarships, the Peter Booras Scholarship (to a student pursuing a teaching career), the Carol Gomez Scholarship (to a student in the Delaware Valley Mensa area), the Rita Levine Scholarship (to a woman who re-enters academic study after a period of employment or family management), and the Howard Turney Award (for study in engineering, mathematics, medicine or the physical sciences).

Intelligence—how we achieve it and what we do with it—is the realm of the Mensa Research Journal. The Journal publishes scholarly articles, most of which have won Awards of Excellence presented by MERF to researchers throughout the world, and the proceedings of the Mensa Colloquia.

Recent topics include a theory to explain why Asians score so well on intelligence tests; gender differences in SAT scores; what has happened to students who entered college at an early age; the correlation between giftedness, myopia and allergies; and selected papers from Colloquium III, the Impact of the Arts on Civilization.

In conjunction with American Mensa, MERF sponsors weekend-long Colloquia on serious issues. Authorities are invited to address those who participate; they, in turn, meet in informal, structured groups to further explore these issues. Colloquium IV will be held in October in Austin, Texas. The theme is "Science and Society: The Human Connection." Themes for prior Colloquia have been: The Impact of the Arts on Civilization (1986), The Gifted in Society (1984) and Forecasting a Valid Tomorrow (1982).

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**Staff:**

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# Editor's Preface

I'll never forget the burst of excitement and satisfaction that came over me when I read the manuscript for the first issue of the *Mensa Research Journal* that I edited—Number 21, the one about the Search for Mathematically Precocious Youth conducted by Dr. Julian Stanley at Johns Hopkins University. It made me feel that all those years of beating my head against the wall of teachers and school administrators who do not believe in accelerating gifted children were worth it. My own children did not skip grades, because I tired of the head-banging and gave in, but my feelings never changed, and with the publication of Number 21, I was vindicated.

I felt almost the same surge (it's never quite the same after the first time, you know) reading the manuscript for this issue. Once again, the Mensa Education and Research Foundation has presented an Award for Excellence for a body of work in the field of gifted intelligence which is inspiring to those who work in the field, to parents of gifted children, to people who used to be gifted children, and to fans of intelligence everywhere. John Feldhusen and his colleagues have put together a remarkable collection of their research and thought about gifted children and what to do with them. Dr. Feldhusen's Gifted Education Resource Institute at Purdue University is disseminating the work he and his associates have done and are continuing to do. As Dr. Stanley's program is aimed primarily at finding gifted children and providing educational options for them which might otherwise be unavailable, Dr. Feldhusen's program is aimed primarily at those who educate or in other ways work with gifted children, teaching them how to do it with the greatest result.

Also in these pages you'll meet Terry Tao, an exceptionally gifted child growing up in the egalitarian society of Australia. Miraca Gross, a teacher in Australia who is, incidentally, currently a Ph.D. candidate in gifted education at Purdue, writes a charming, personal story about Terry and how his parents are overcoming Australia's tendency to minimize intellectual differences among its diversity of people, as well as the tendency of all parents to expect too much, or too little, from their children.

Not all the winners of this year's Awards for Excellence are printed in this issue; space is always a problem. But I think the ones we've chosen are indicative of the high quality of the entrants, as well as well-written and enjoyable to read.

Phyllis Miller
Editor

# Letters

**To the Editor:**

Richard Lynn's first subtheory (issue #23) is refreshingly informative, but Lynn's second subtheory, to wit, that "the extreme cold of the Ice Ages" resulted in Mongoloids having higher intelligence than Caucasoids, is contradicted by human fossil and artifactual evidence from pre-history. The evolutionary status of Caucasoid fossil men, judged by their skulls as well as the development of their stone tools and other cultural artifacts, was more advanced than those in East Asia throughout the Ice Ages, not less advanced as Lynn's theory suggests.

The earliest Ice Age from which we can compare European and East Asian fossil men is the Mindel (Elster) glaciation. The famous fossil assemblage known as Peking man dates from late Mindel times (about 400,000 years BP). Peking man was racially Mongoloid; his fossils have 17 special anatomical features that still appear in today's Chinese, Japanese and Amerindians, such as distinctly Mongoloid dentition (especially shovel-shaped incisor teeth), a rounded contour of the nasal saddle, Inca bones (an area of many criss-crossed sutures creating a jigsaw-like pattern in the back of the skull, common to Mongoloids), rounded infraorbital margins, and 13 other telltale skeletal characteristics.[1]

Peking man was in the Homo erectus stage of evolution; his skull was primitively shaped, with a low brow and an average adult cranial capacity of 1043cc; the largest cranium was 1225cc.[2] Meanwhile, during the Mindel Ice Age, European man was very different. His 400,000-year-old fossils found in a terrace of the Danube River near Vertesszollos, Hungary, show that big-skulled Europeans were already in the early Homo sapiens stage of evolution. Vertesszollos man's cranial capacity was 1400cc.[3]

Some other archaic Homo sapiens fossils more than 250,000 years old are from Petralona, Greece, Steinheim, Germany, and Swanscombe, England. European man possessed "sapiens" taxonomic status exclusively for hundreds of millenia while Ice Ages came and went.

In East Asia the transition from Homo erectus to Homo sapiens only began about 20,000 years ago.[4] It can be seen progressing in Mongoloid fossils beginning with Mapa man (about 200,000 BP) found near Shaochuan, China, the Hsuchiayao man (about 100,000 BP) found near Datong, China, then Dali man, found in Shensi, China.[5] The earliest fossil of a modern Homo sapiens in East Asia is Liujan (Liu-kang) man, dating to 40,000 BP).[6]

Prehistoric artifacts corroborate the human fossil record. During the Ice Ages the Caucasoids developed dynamically better stone tool technology than the Mongoloids. Anthropologists separate the western stone age from the (quite different) eastern stone age with a line on the world map called Movius' line (it splits India). The first kind of stone tools manufactured worldwide were what we call Oldowan stone tools, or "choppers," essentially stones simply sharpened by knocking off big chunks, which resulted in an uneven cutting edge. West of Movius' line Oldowan methods became obsolete in remote antiquity; thereafter newer methods of stone tool manufacture progressed up through flake industries (Clactonian), bifacial hand axe industries (Acheulean), prepared-core industries (Levalloisian), and reached by Cro-Magnon times a state of complex tool kits that included stone blades, burins, points with cleft bases, bone needles, and a new weapon that could kill from a distance, the spear thrower. Note the application of visuospatial ability to tool making. East of Movius' line no such development occurred. Instead, the primitive Oldowan stone tool industry continued unchanged in East Asia until 10,000 BP, hundreds of millenia after the Caucasoids left Oldowan methods behind.[7] (Some primitive inheritors of the eastern stone age on Pacific Islands still make Oldowan stone tools. [8]) If, as Lynn suggests, the Mongoloids evolved and lived by superior intelligence in the Ice Ages, why did they manufacture profoundly inferior stone tools?

The most recent Ice Age from which we can compare European and East Asian fossil men is the Würm (Weichsel) glaciation. By 40,000 years ago (Würm times) the Mongoloids, judging from their skulls, were the evolutionary equals of the Caucasoids, as is represented by the cranial capacity of the aforementioned Liujang man (1480) and by the later Würm Ice Age Mongoloids from the Upper Cave at Choukoutien (one male, 1500cc, and two females, 1300cc and 1380cc).[9] Contemporaneously in Europe the Cro-Magnons' cranial capacities averaged 1580 cc male and 1370 cc female.[10]

But there is no parity in artifactual remains. Besides grossly unequal stone tool industries, the difference between Cro-Magnon caves and Asian caves like the Upper Cave at Choukoutien is that there was no art yet in East Asia. Cro-Magnon art (note visuospatial skill) included paintings of moving animals, ivory and bone carvings and clay sculptures.[11] The world's oldest known musical instrument is a Cro-Magnon flute, dated 32,000 BP. By contrast, rudimentary art—geometric designs on clay as well as rough fish and bird designs—didn't appear in East Asia until 7,000 BP.[12] That's a 25,000-year lag.

Burials indicate thought. The oldest graveyards in Europe date to 60,000 BP at LaFerrassie and Le Moustier, France.[13] The oldest graveyard in East Asia only dates to 6,000 BP, at Ban Chiang, Thailand.[14]

The Caucasoid lead in cultural accoutrements didn't melt away when the Pleistocene Epoch ended. Consider these milestones of the Holocene: The first Caucasoid civilization was the Sumerian, about 3500 BC, and others soon followed; the first Mongoloid civilization was the Shang dynasty, about 1750 BC. Writing first appeared in Sumer about 3100 BC, and shortly thereafter in other Caucasoid cultures; writing first appeared in China about 1300 BC.[15] The wheel was invented by Sumerian Caucasoids about 3500 BC and traveled up the Danube into Europe; it didn't reach China until about 1500 BC.[16] (The wheel and axle are a visuospatial concept.) Sumerians and Greeks worked in copper, brass, bronze, gold, silver and lead in the 4th millenium BC, and by 3,000 BC the larger western Bronze Age began.[17] The earliest Mongoloid metal work comes from a level of Ban Chiang dated to 2,000 BC, but the larger Yin Bronze Age didn't begin in East Asia until 1500 BC.[18] Both Caucasoids and Mongoloids had astronomy since the dawn of history, but it was the Caucasoids (ironically, the Jesuits) who informed the surprised Mongoloids that the Earth rotates on its axis and orbits the sun (visuospatial concepts).[19] The Mongoloids in Asia built sailing ships but somehow never discovered most Pacific islands. Captain Cook charted the Pacific and Australia. Tasmania bears the name of a Dutch sailor. More recently Goddard, Von Braun and Armstrong sailed to the Sea of Tranquility. Aristarchus, Guttenberg, Newton, Pasteur, Darwin, Mendel, Daguerre, Marconi, James Clark Maxwell, Einstein, Poincare, Edison, the Wrights, Bell and Salk are all part of a larger Caucasoid techno-cultural whole; sometimes different men made the same discoveries simultaneously.

In my opinion Mongoloid inventions pale by comparison. The Mongoloids are credited with giving the world gunpowder (but not guns), paper, ceramic stoneware, spaghetti, silk and printing (with wooden blocks.)

Nothing in this letter should be construed as challenging the results of the IQ tests cited by Lynn. I'm aware of the current rocket-like Asian rise to the top of the western world. The point here is that we have a paradox in view. Here are a few possible explanations for the dichotomy between racial history and racial performance on IQ tests: 1) perhaps verbal abilities were more important for producing today's techno-culture than visuospatial abilities. 2) Perhaps biological factors other than IQ prevail in creating culture. The University of Minnesota's study of identical twins who were separated at birth has found the separated twins' lives contain striking behavioral parallels, and indicates there is a world of behavioral genetics we yet know nothing about. Other recent studies strongly indicate that personality traits like shyness, or strong will, or compliant behavior are inborn. Anyone who has ever taken any drug, from aspirin to LSD, will understand that a little bit—milligrams—of chemical change in a person's bloodstream can change the whole sensorium and behavior. Racial differences in biochemistry may play a larger role than hitherto considered. 3) Perhaps the Asian Mongoloid gene pool is undergoing an evolutionary surge in intelligence at this time, punctuating their equilibrium now. 4) Perhaps Caucasoid brain power is slowly deteriorating, while Mongoloid brain power is slowly evolving, and the two lines of change have just passed each other. In *Why Civilizations Self Destruct* by Elmer Pendell (Howard Allen, 1977) Pendell suggests that in the bosom of an altruistic society the less intelligent people out-reproduce the more intelligent people. He cites U.S. census figures showing a pronounced inverse relationship between (economic) achievement and reproduction rates over the last five generations. For the long-term picture observe that Cro-Magnon males had an average cranial capacity about 100cc larger than today's Caucasoid males. Cro-Magnon females had crania about 35cc larger than today's Caucasoid females. The Mongoloids have no such deficit compared to their ancestors; moreover, their crania are now larger than those of Caucasoids (for both sexes combined, Mongoloids average 1448 cc, Caucasoids 1408cc).[20] 5) Here's a long shot: perhaps a modern lack of breastfeeding downturns western IQ statistics. According to Rita Law's article in the *American Mensa Bulletin*, May 1987, "The Real Brain Food: Breastfeeding and IQ," in a survey sample of the IQs of schoolchildren, those who had been breastfed as infants strongly outscored those who had been bottle-fed. A baby's brain isn't fully developed at birth and one hypothesis suggests that human milk contains biochemicals that encourage postnatal brain development more than cow's milk does. Since World War II most western babies have been bottle fed.

Whatever the answer is, one thing is certain: the IQ gap between Mongoloids and Caucasoids isn't a result of the Ice Ages. The evidence from the Pleistocene epoch strongly indicates that the Caucasoids were comparatively more advanced.

Glen Chambers
410 Riverhills Drive
Temple Terrace, FL

## FOOTNOTES

1. Carleton S. Coon, *The Origin of Races* (Knopf, 1962) pp. 452-460.
2. Coon, p. 438.
3. "Vertesszollos man," *Encyclopedia Britannica (1980)*, 10: 407.
4. Leslie Aiello, *Discovering the Origins of Man*, (Stonehenge, 1982) p. 72.
5. Aiello, pp. 72-73.
6. Aiello, p. 82.
7. Most references on paleoanthropology will discuss Movius' line, but often seem obliged to make (always dissimilar) excuses for the non-egalitarian significance of it. The *Encyclopedia Britannica* (1980) 2:204 calls the longevity of the primitive Oldowan stone tool industry in East Asia "hard to understand" and elsewhere suggests that the Asians might have made advanced tools out of bone, wood and horn, all of which have disappeared into the dust. Another volume of the same set (II:887) suggests that a lack of the right kind of stone in the east "helps explain why stone toolmaking did not evolve in Asia as in the west." This excuse ignores the fact that flint doesn't occur naturally in much of Europe, that quartzite was used to make tools in both Europe and East Asia, and other geological facts. Another author I've read suggested that the Asians "chose" not to make better stone tools for hundreds of thousands of years. These authors are struggling to write egalitarian dogma in an intrinsically non-egalitarian field of study. After a certain point too much tact becomes pure deception. Since Richard Lynn has opened a controversy on racial inequities, it's fair to bring the significance of Movius' line out of the prehistoric closet.
8. Coon, p. 326, p. 331.
9. Coon, Appendix, Table 37.
10. Coon, p. 584.
11. William Culican, "Stone Age European Peoples, Arts of," *Encyclopedia Brittanica* (1980) 17:702.
12. Shin Ici Tani, "Visual Arts, East Asian," *Encyclopedia Britannica* (1980) 19: 174-177.
13. F. Clark Howell, *Early Man* (Time Life, 1973) p. 128.
14. "Where Was the Cradle of Civilization?" *Reader's Digest*, p. 69.
15. Ignace J. Gelb, "Writing, Forms of," *Encyclopedia Britannica* (1980) 19:1033.
16. Marie Nice Boyer, "Wagons and Carriages," *Encyclopedia Brittanica* (1980) 19:520.
17. "Bronze Age," *Encyclopedia Brittanica* (1980) 2:297.
18. Ibid.
19. George Abett, *The History of Astronomy* (Schuman, 1952); see also Carl Sagan, *Cosmos*, p. 186.
20. These figures are from a paper published by J. Phillipe Rushton, University of Western Ontario, Canada, 1987.

(Continued on Following Page)

**To the Editor:**

As one of the scholars asked to contribute to the commentary on Richard Lynn's evolutionary theory on the intelligence of Mongoloids, I would like to prevail upon your readers' patience by discussing some of the points raised by some of the other contributors and by Lynn himself in his response.

It seems to be accepted that the Kalahari Bushmen and the Australoids do not exhibit the high spatial and low-verbal profile seen in Mongoloids including the Eskimos. Christopher Brand and Nathaniel Weyl (*MRJ*, 24, 7–9, 6) both question Lynn's thesis on this account as both primitive hunting peoples face up to their "own equally unpropitious environment." In order to understand this fact, it is instructive to consider the recent history of the Bushman.

From the evidence of skeletal remains and rock art, the Bushmen occupied most of southern Africa. From 1655, the first recorded contact between the Bushman and Europeans, there ensued a war of increasing savagery which continued for 170 years. A.R. Willcox in his book *The Rock Art of South Africa* (1963, Nelson, Johannesburg) outlined "the history of a people who fought for their freedom to live in their own way until hardly an able-bodied man was left alive, and whose fighting qualities and fearlessness of death compelled the admiration of their bitter foes." The history of the Bushman is of continual retreat with fierce resistance at every step, until finally surrounded by enemies and annihilated. The last survivors were driven to subsist in the Kalahari. The Bushman inhabited an environment that was not at all "unpropitious"; he was driven by force out of his lands into the wilderness.

The history of the Australoids follows much the same pattern. It is only in recent historical times that the Bushmen and Australoids have been obligatory inhabitants of marginal environments. They do not present any kind of contrary example to the case for Mongoloid specializations presented by Richard Lynn.

The attempt to discuss human racial differences in terms of contrasting styles of reproductive strategy, more properly r/K selection, seems to me to be singularly inappropriate and wildly simplistic (J. Philippe Rushton, *MRJ*, 24, 30–32). It is not just a matter of a trade-off between egg production and parental care. The life history and reproductive strategies of organisms relate to two factors: dispersal from a population and persistence in a population. A key aspect is whether a population is expanded or is stable. With an expanding population and no mortality, the instrinsic rate of natural increase is known as r; when the population reaches the point where there are no further resources to allow any more increase, then the population has reached its carrying capacity or K. r-selected species are adapted for increase and dispersal in new environments. K-strategists are adapted to stable environments; r-strategists are better adapted for disturbed environments.

If the Bushmen, Australoids and Amerindians are studied from this standpoint, they all illustrate classic K-selection strategies. The advent of the Europeans in South Africa, Australia and North America can similarly be used as classic examples of r-selection strategies. The history of the Mongoloids must again be seen as quintessential r-strategy.

Since the major periods of expansion and settlement in the past few hundreds years—periods of r-strategy—most aspects of human society have settled down into K-strategy. There is no sense whatsoever that modern human races can be compared in terms of r/K reproductive strategies; such an attempt brings the entire concept into disrepute.

The origin of human races, however, still remains a subject of controversy. In my contribution (*MRJ*, **24**, 15–18) I stated that "the evolution of modern races seems to be characteristic of the Flandrian or post-glacial epoch of the last 10,000 years." In his response to the discussion of his original paper, Richard Lynn (*MRJ*, **24**, 34–37) refers to proto-Mongoloid peoples being established in northeast Asia approximately 500,000 years ago.

This dramatic discrepancy of 10,000 or 500,000 years for the origin of modern human races is explained by the existence of the two current competing models for recent human evolution. These have been discussed in detail by C.B. Stringer and P. Andrews of the British Museum (Natural History) London, in their article "Genetic and Fossil Evidence for the Origin of Modern Humans" (*Science*, **239**, 1263–1268, 11 March 1988). In the multiregional model it is suggested that the racial variations of modern humans began with the initial spread of *Homo erectus* from Africa into other regions of the world where they established their own local populations, which through a series of evolutionary grades produced the present varieties of *Homo sapiens*. This contrasts with Coon's version which insists that modern races are the result of the independent evolution of the separate regional lineages (C.S. Coon 1962, *The origin of races*; Knopf, New York).

In the multiregional model, racial difference are derived from local populations of *Homo erectus* and appeared before the establishment of *Homo sapiens*, hence Lynn's 500,000-year-old proto-Mongoloid.

The "Noah's Ark" or single origin model postulates a recent African origin for modern humans. This model removes the need to postulate a series of parallel evolutions and predicts that there will be greater genetic variations among African populations, that transitional fossils will not occur outside of Africa and sudden replacement would be the mode of the establishment of *Homo sapiens* outside of Africa. The studies of mitochondrial DNA and also of blood groups show genetic distances which indicate an African-nonAfrican split about 110,000 years ago and a subsequent European-Asian split 40,000 years ago.

With regard to fossil materials, early *Homo sapiens* fossils from Africa and Asia are very similar. The east Asian and Australian *Homo sapiens* from Choukoutien and Mungo, respectively, are more similar to fossils from Europe and the Middle East than would be the case if the multiregional model had operated.

The evidence from both fossils and genetics points towards a recent origin for modern racial distinctions, with Mongoloid traits being associated with the latter part of the last glacial period, the Devensian (Weichsel, Valdai, Würm, Wisconsin).

Beverly Halstead
10, Belgrave Crescent
Bath, BA1 5JU United Kingdom

# MERF Awards for Excellence

*Joan E. Bauman*
Mensa Director of Science and Education

Among the purposes of the Mensa Society, as set forth in the first paragraph of the Constitution of Mensa, is "to encourage research in the nature, characteristics and uses of intelligence...".

The Mensa Education and Research Foundation (MERF) has as part of its mission the task of carrying out this admittedly broad ambition. One of the ways that MERF seeks to encourage research on intelligence is through publication of the *Mensa Research Journal*; another is through a program of monetary awards to researchers who have done valuable work in the area of intelligence. In this issue of the *MRJ*, the two come together, as we reprint the papers that earned their authors Awards for Excellence in the 1987-88 awards program.

In order to qualify for an award, a paper must have been published (or accepted for publication) by a scholarly journal or presented (or accepted for presentation ) at a professional meeting; in either case, the article will have been subjected to peer review by professionals. Subject matter of the research may be almost anything relating to intelligence (with emphasis on the high end of the intelligence spectrum), and therefore might originate in the field of psychology, education, neurophysiology, biochemistry, sociology, intelligence testing, or even artificial intelligence. For more information on submitting a paper for an award, write to me at the address below.

Judging of the awards is done by Mensa's Research Review Committee. Currently there are five committee members, who themselves have scientific credentials in widely varied fields. Dr. Abbie Salny is American Mensa's and Mensa International's supervisory psychologist; she is an expert on intelligence testing. Dr. Jean Harrod has qualifications in developmental psychology and counseling psychology. Nancy Alvarado Stone is a psychology graduate student with a special interest in the education and counseling of gifted children. Robert Burgermeister is a computer scientist. As Mensa's Director of Science and Education, I am (ex officio) chairman of the Research Review Committee. My degree is in biology with a minor in chemistry, and I work in medical research.

All members of the committee read and review each paper submitted, and awards are made on the basis of the summation of the ratings and opinion statements given by the committee. The decision is never an easy one to make, but we are delighted to be able to make awards to the authors of quality papers such as those reprinted in this volume.

Dr. Joan E. Bauman
4636 Candleglow Drive
St. Louis, MO 63129

# A Conception of Giftedness: Intelligence, Self Concept and Motivation*

*John F. Feldhusen and Steven M. Hoover*

There is much interest in the components of giftedness. The interest often arises from the assumption that giftedness and/or talent are relatively stable, possibly genetically determined, characteristics of individuals, that such characteristics can be measured at points along the way in the growth of individuals, and that the growth of these characteristics may predict high-level productivity or creative achievement later in the life of individuals. Generally, all of these conceptions hypothesize a role for intelligence in defining giftedness. While more recent conceptualizations of giftedness have tended to include other nonintellective factors, intelligence continues to have a prominent place in these definitions.

## Current Conceptions of Giftedness

One conceptualization which, in addition to intellectual functioning, includes chance factors or events that may operate throughout the lives of human beings and which may be major determinants of productive and creative achievement, was put forward by Tannenbaum (1983). This particular definition includes (a) general ability (intelligence), (b) special abilities (or talents), (c) nonintellective factors, (d) environmental factors, and (e) chance factors. While this conceptualization recognizes the necessary role of intellectual functioning, both in general ability as well as in special talents, it also reminds us that gifted achievement or productivity is potentially influenced in many ways by the inter- and intrapersonal relationships between the individual and the social, intellectual and physical environment.

Tannenbaum offers the following concise definition of giftedness:

> Keeping in mind that developed talent exists only in adults, a proposed definition of giftedness in children is that it denotes their potential for becom-

**JOHN F. FELDHUSEN** is director of the Purdue Gifted Education Resource Institute. He is past president of the National Association for Gifted Children and a Fellow of the American Psychological Association.

**STEVEN M. HOOVER** is associate director of the Purdue Gifted Education Resource Institute.

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> ing critically acclaimed performers or exemplary producers of ideas in spheres of activity that enhance the moral, physical, emotional, social, intellectual or aesthetic life of humanity (1983, p. 86).

He goes on to suggest that a g factor, or general intelligence, is involved on a sliding scale in all high-level talent areas. However, he also suggests that considerations of general intelligence are relatively meaningless unless we also look to the role of special ability. While g may play a significant role, giftedness really means doing exceptionally well something that is highly respected. Very few people do many things exceptionally well. They are talented in particular areas.

Intelligence also plays a role in the most well known conception of giftedness in the United States and, possibly, throughout the world: Renzulli's three-ring conception. In a now famous 1978 publication Renzulli asserted that the major determinants of gifted behavior are above-average ability, creativity, and task commitment. This conceptualization has been implemented through the "Revolving Door" identification model (1981), and has been widely used to provide programming for gifted youth.

## Motivation

In a recent discussion of the definition of giftedness, Gagne (1985) has seriously questioned the manner in which motivation (task commitment) is used in relation to giftedness. The question raised by Gagne relates to a concern that Renzulli's definition, where implemented as an identification model, will serve as a serious impediment in attempting to provide services for underachieving gifted students. Gagne also asserts that motivation is not a part of giftedness, but a catalyst or facilitator.

This concern over the role of motivation in defining giftedness may stem, in part, from the distinction between antecedent traits and outcome behavior. The former, antecedent traits, refers to those constructs which we can assess in an individual as a measure of his/her potential, while the latter refers to those abilities or behaviors we hope our program will promote in those individuals who possess some measured potential.

This inclusion of motivation as a component of giftedness is not new. Galton (1969) and Terman and Oden (1959) included it in their definitions of gifted. However, their conception of motivation focused more on the traits of persistence, drive, energy and interest and less on the conception of periodic bursts, as the task commitment construct of Renzulli implies. Motivation is, of course, properly viewed as a combination of an internal predisposition to initiate, sustain and terminate behavior in well defined areas as well as external stimulating conditions which activate, sustain or depress behavior. Thus, properly conceived, motivation is a combination of internal and external (to the individual) factors.

## Self Concept

Self concept and self esteem are probably major influences which impel an individual to work, to investigate, to learn, to solve problems, to strive, to achieve, to compete. Feldhusen (1986) reviewed self concept and self esteem aspects of gifted and creative individuals and suggested that self conception should be viewed as a component of giftedness and/or talent. Perhaps it would be better not to imply a homunculus called "giftedness" or "talent" within the individual but rather to assert a set of psychological predispositions or characteristics which are associated with gifted or talented performance. Self concept and self esteem may then be viewed as correlated conditions, in the individual and external facilitating factors which may give rise to gifted and/or talented behavior. In other words, the intrapersonal factors of intelligence, self concept, and self esteem may provide for the overt motivational predisposition necessary for creative accomplishment. This conceptualization therefore implies a relationship, in gifted individuals, among self concept, self esteem, and a realization of individual ability or potential.

Feldhusen and Kolloff (1981) reported on the development of a new scale, ME, to measure self concept in gifted children. This instrument focuses on specific characteristics of the gifted which affect their self perceptions and their interactions with adults and peers of average and high ability. Initial validity studies indicate that the ME scale is effective in measuring the unique conceptions of self of gifted students. Nielsen (1984) used the ME scale in research with gifted children in grades 3 through 8. She found that student participation in a gifted program at the third through eighth grade levels improved self concepts related to giftedness (ME scale) significantly. This was not the case, however, with the more generalized aspects of self concept as measured by the Piers-Harris Children's Self-Concept Scale (1964). This research indicates that gifted youth may have self concepts which clearly relate to and recognize giftedness and that their self concepts may be influenced positively by participation in a gifted program.

## Multiple Factor Theories of Intelligence

In this whole framework of conceptions one must surely also pay close attention to Gardner's (1983) theory of multiple intelligences and Sternberg's (1981) componential theory of intelligence and giftedness. From Gardner we have (a) linguistic intelligence, (b) musical intelligence, (c) logical-mathematical intelligence, (d) spatial intelligence, (e) bodily kinesthetic intelligence, (f) access to one's own feeling life, and (g) ability to notice and make distinctions among individuals. While little empirical support is offered for the Frames of Mind, the arguments presented by Gardner are persuasive and to a great extent consistent with theories of intelligence derived from factor analysis.

Gardner's multiple intelligences can perhaps best be viewed as representing general areas or fields of ability as described by Gagne (1985) and not as specific talents. We shall discuss Gagne's distinction in greater detail later in this paper, but for now we might simply suggest that the multiple intelligences posited by Gardner represent intermediate stages of intellectual differentiation between intelligence as g or general, and talent as specific to performance in a particular field. Thus, while Gardner proposes musical ability as one form of intelligence, general intelligence is the broader, more pervasive representation of ability while competence on the piano is a specific form of talent. Giftedness, then, really involves an evolution of ability from its general form as intelligence in youth, to the more specific frames suggested by Gardner, and finally to specific talents as proposed by Gagne.

Sternberg (1981) views all of the components of intelligence as information processes or as metacomponents of cognitive control. Gifted individuals excel in the following six components:

1. decision as to just what the problems are that need to be solved;
2. selection of lower-order components of problem solving;
3. selection of strategies for solving problems;
4. selection of representations for information;
5. decisions regarding allocation of componential resources in problem solving; and
6. solution monitoring in problem solving.

The metacognitive processes are:

1. inference: detecting relations between objects;
2. mapping: relating aspects of one domain to another;
3. application: predicting on the basis of perceived maps;
4. comparison: the examination of a prediction in relation to alternative predictions;
5. justification: a process of verifying options; and
6. Response: communicating a solution.

Perhaps the major conclusion to be drawn from the work of Gardner and Sternberg is that the characteristics or set of traits which we have called intelligence and have viewed as an homunculus or entity in the individual is really a complex set of psychological phenomena which may emerge as powerful combinations in some individuals and give rise to highly effective problem-solving behavior, creative production, or performances.

## Special Talents

There is no theory of special talents, although the multiple intelligences of Gardner imply special talents or abilities. Renzulli (1979) also recognizes the ability ring as including quite specialized talents, skills or aptitudes. Aptitude test theory, largely derived from factor analysis, also implies special, narrower abilities in the constructs which aptitude tests measure. In addition, Tannenbaum (1983) set forth a theoretical conception of talents which included (a) scarcity talents, (b) surplus talents, (c) quota talents, and (d) anomalous talents. Scarcity talents are those possessed by great leaders in science and politics which are desperately needed by society to solve problems. Surplus talents are possessed by people, especially in the arts, who, while not desperately needed to solve problems, make life better for others. Quota talents are the abilities which make possible the skilled or professional behavior of a large number of leaders in our society who otherwise make minimal creative contributions. Anomalous talents are narrow but superior skills such as superior marksmanship, speed reading, and so forth.

Gagne (1985) has also offered a discussion of the concept of talent. He suggests that in general usage there is often little or no distinction made between the concepts of giftedness and talent. He suggests that the definitions of giftedness presented in the Marland report (1971) simply added to the ambiguity of the situation and did little to clarify the distinctions among intelligence, giftedness and talent. More recently the research of Richert, Alvino, and McDonnell (1982) showed that the entire field of gifted education is beset by varying and conflicting definitions of the relationships among giftedness, intelligence and talent.

Gagne goes on to define giftedness as exceptional competence in one or more broad domains of ability, and talent as exceptional performance in one or more specific fields of human endeavor. He further argues that motivation (or task commitment) is not really a component of giftedness but rather a critical catalyst or energizer. In a comprehensive explanatory model Gagne presents motivation, personality factors and environmental influences as the interface between general giftedness and the emerging talents.

## Creativity

The role of creativity in the field of gifted education is surely troublesome. While few, if any, people would argue that creativity does not play a major role in eminence or unique productive achievement, a problem similar to the issue of motivation arises. Since Torrance (1984) argues strongly for the necessity of including creativity in procedures to select students for programs, the issue of antecedent traits versus outcome behaviors becomes relevant. As with motivation, it may be more appropriate to attempt to develop creativity in all those individuals who have been identified as possessing potential for high-level achievement rather than to exclude anyone on the basis of scores on poorly validated creativity instruments. For the present there are no high-quality tests of creative ability (Vernon, 1971; Tannenbaum, 1983).

Furthermore, truly creative accomplishment in many fields of endeavor, such as science and math, may in fact be the result of problem-solving procedures similar to those which Sternberg (1985) has posited as a subtheory of insight abilities. The processes include selective encoding, selective combination and selective comparison. Sternberg proposes (1985) that these insight abilities are really synonymous with giftedness since they indicate potential for discovery of new concepts, which he sees as the ultimate expression of giftedness. In selective encoding, the more proficient problem solver is better able to select the relevant aspects of the problem situation which are to be dealt with. Secondly, in selective comparison, the better problem solver is more adept at searching her store of knowledge to find past situations which are similar to the current problem and may therefore represent or suggest solutions. Finally, and possibly most closely associated with general conceptions of creativity, is selective combination. It is here that individuals, in conjunction with selective comparison, synthesize solutions by selectively combining bits and pieces from previous experience. Sternberg's conception of insight not only explicitly includes these three components, but also implies the necessary acquisition and use of an extensive knowledge base within the realm of the problem. This is not, however, to suggest that knowledge brought to bear upon a problem could not come from other than the field of the problem, since, as Kuhn (1970) points out, many creative accomplishments or revolutions in science have come about from individuals who are new to the particular field.

## The Conception Which Emerges

Our own view is that giftedness will usually consist of superior general abilities (intelligence) from the catalog of intelligences proposed by Gardner and Sternberg's components of intelligence, special focused talents which predispose an individual to high-level achievement within one area of human endeavor, and a conception of self which views high-level creative achievement or production as attainable, resulting in a motivation to acquire a large knowledge base and to achieve. The ability to think well, to process information effectively, to achieve insights and solve problems, and to use efficient metacognitive processing systems, as proposed by Sternberg, is a part of the complex bundle called general abilities. It underlies giftedness in all fields. But the course of development of giftedness is from general intelligence to the more particular abilities proposed by Gardner, to the specific talents suggested by Tannenbaum and Gagne (Keating, 1979).

The field of gifted education is obsessed with finding measurement procedures which can be used to identify those few youths who are "truly gifted" and/or destined to high-level creative achievement in adulthood (Feldhusen, Asher and Hoover, 1984). Given that a number of components of giftedness are highly modifiable and subject to change as youth grow and develop, a wiser educational strategy might be to try to optimize the growth of the components of giftedness in as many individuals as possible. Thus, identification procedures and educational programs should seek to be as inclusive as possible and to offer multilevel (Van Tassel-Baska, 1984) and multiservice programs (Feldhusen, 1982) to meet the needs of a large number of potentially gifted youth. In addition to offering excellent intellectual and/or artistic growth experiences for gifted youth, much more attention should be devoted to the provision of instruction in special talent areas starting early in the life of a child. Bloom and Sosniak's (1981) recent report of the genesis of talent in high-achieving adults indicates that a talent focus was achieved in childhood, and there was steady nurturance of talent starting early in life.

The self concept, motivation, and creativity components should probably never be identification factors for gifted programs but instead should be program goals. Gifted youth should have the opportunity to explore and clarify their conceptions of their own abilities, talents and potentials and to become aware of appropriate higher-level career opportunities. Hopefully, then, there emerges a conception of self which envisions high-level creative accomplishment as possible. Such a conception, when united with a stimulating environment, will support motivation to strive for high-level goals, to accept the demands for hard work, and to see the need for intensive energy output. Gifted youth need demanding teachers, coaches or mentors who will help them learn to think hard, stick to tasks, practice long hours, and strive for excellence (Bloom, 1982).

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## Summary

Gifted and talented youth are characterized by superior general ability and/or aptitudes and talent, by a self concept which recognizes their special abilities and their potential for the individual, and by higher-level motivation and achievement goals. Identification of these youth must focus chiefly on their abilities, aptitudes and talents. Educational programs for gifted and talented youth call for excellent and demanding teachers and a combination of acceleration and enrichment to meet their special needs.

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# The Effects of Enrichment on Self-Concept and Creative Thinking*

*by Penny Britton Kolloff and John F. Feldhusen*

Current problems in gifted education generally focus on two areas: the lack of both systematically developed models and systematic experimental evaluation of programs and program models with explicit goals, objectives and specified outcomes (Busse & Mansfield, 1980; Juntune, 1979; Renzulli, 1980). Many programs are implemented without these considerations and become haphazard collections of unrelated games and puzzles.

Evaluation of programs and program models has been less than rigorous. Where experimental evaluation is called for, program evaluation is frequently based on attitudinal instruments. There have been few studies in which a control group of gifted students has been used to evaluate program outcomes.

## Statement of the Problem

There is a proliferation of programs providing services to gifted and creative students. A number of the programs lack any theoretical basis for program structure. Few models for appropriate programs have emerged and been tested or validated in terms of their effectiveness with gifted students. Many existing programs purport to develop the creative thinking abilities and self-concepts of participants by means of program activities, the skills of the teachers, or the atmosphere in which a program is carried out. Yet, few studies seek to systematically measure the extent to which these programs actually accomplish what they set out to do. Even fewer studies include a control group with which to compare the performance of students in a program.

The literature supports the possibility of changes in self-concept and creative thinking resulting from specified training activities and programs for the gifted as well. The findings are mixed, however, as to whether self-concepts increase or decrease during the course of such a program. Two studies (Fults, 1980; Rodgers, 1979) reported a decrease in the self-concepts of gifted students when placed in groups with others of similar abil-

**PENNY BRITTON KOLLOFF** is director of the Center for Global Futures of the Burris Laboratory School at Ball State University

**JOHN F. FELDHUSEN** is director of the Purdue Gifted Education Resource Institute. He is past president of the National Association for Gifted Children and a Fellow of the American Psychological Association.

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ity. Two other studies found that self-concepts of students increased during the course of a program (Ketcham & Snyder, 1977; Lutfiyya, 1977). Studies which compared the self-concepts of students in programs or special classes with students who were not reported various results (Karnes & Wherry, 1981; Bracken, 1980; Maddux, Scheiber & Bass, 1982).

Results of creative thinking and creative problem-solving studies are generally positive and indicate that, across grade level and sexes, systematic training can increase creative thinking abilities. Certain training programs, such as the Purdue Creative Thinking Program and the Productive Thinking Program, appear to be particularly effective in increasing the creative thinking abilities of children (Feldhusen, Treffinger & Bahlke, 1970; Covington et al., 1972; Alencar, Feldhusen & Widlak, 1976; Moreno & Hogan, 1976). More general approaches to increasing creative thinking and creative behavior, such as creativity training for teachers, also appear to positively influence the creativity of students (Torrance, 1964). Grouping children of similar ability, whether in a special school, a classroom within a school, a resource center or part-time class, or even a nonschool setting, also appears to facilitate the development of creative thinking abilities (Bachtold, 1974; Nash, 1974; Clasen and Subkoviak, 1982).

The purpose of the study was to determine the effects of an enrichment program based on the Purdue Three-Stage Model on the self-concepts and creative thinking abilities of gifted elementary students.

## Methodology

The study was conducted in eight elementary schools in the Tippecanoe School Corporation, LaFayette, Indiana. The grade levels included in the study were third, fourth, fifth and sixth. From the total population of these grades, approximately 420 students were selected on the basis of achievement test scores and teacher ratings of gifted characteristics as being in the top 7 percent and either potentially gifted or of superior ability. These children were then randomly assigned to either an experimental or a control group. Students in the experimental group participated in a pull-out program in which they left their classrooms twice each week for one hour to meet with a trained resource teacher. The name of the program was selected to reflect its scope and focus: Program for Academic and Creative Enrichment (PACE).

## Treatment: The Three-Stage Model

PACE was based on the Purdue Three-Stage Model for Gifted Education (Feldhusen & Kolloff, 1978; Kolloff & Feldhusen, 1981). Broad goals for an enrichment program based on the model included the development of basic creative thinking and problem-solving abilities; the development of higher-level thinking skills, independent study and research skills; and the development and maintenance of positive self-concepts through interaction with other gifted students.

Initiatory activities in the implementation of Stage 1 of the model were designed to facilitate the development of creative thinking abilities, primarily fluency, flexibility, originality, and elaboration. These abilities were to be developed and practiced through short span activities which focused on one or more of these components of creative thinking. The activities were selected and directed by the resource teacher who planned a balance among the types of creative thinking and between the verbal and nonverbal or spatial content. Both convergent and divergent types of activities were presented. Students learned to work with problems and tasks for which there were a number of correct or appropriate responses, as well as those for which the single correct answer was not readily apparent. One of the major purposes for Stage I was to give students experiences which required them to probe, to hypothesize, to test, to brainstorm, and to manipulate information mentally. Several weeks of practice in this type of activity provided the students with a firm foundation in these basic thinking skills.

The transition between Stage I and Stage II in PACE began approximately three to four weeks into the program. The stages led naturally into one another, each building on skills and knowledge acquired from the previous stage or stages. The next logical step was to apply Stage I skills, as well as new learning, to the process of creative problem solving. Most models for gifted education recognize the importance of problem solving in the futures of gifted individuals. It is reasonable to expect that many of these students will be involved in careers and experiences which will require creative problem solving skills in dealing with complex problems for which single, straightforward solutions do not exist. Preparation for these experiences may begin with activities such as those which comprise Stage II. This stage of the model is based on the works of Osborn (1963) and Parnes, Noller and Biondi (1977), with additions and adaptations suggested by Gordon (1961), Feldhusen and Treffinger (1980), and several others who have developed particular strategies for problem solving.

The process of teaching problem solving to PACE students began with the introduction of a number of strategies, each of which was introduced in isolation. Opportunities were given for practicing the strategy, using appropriate problems or situations. Among the techniques introduced were brainstorming, inquiry, morphological analysis, synectics, attribute listing, and forced association. Several weeks were devoted to the practice of the various strategies which would prepare students for a systematic problem-solving process. Emphasis in these sessions was on the generation of many ideas, while deferring judgment, and the eventual evaluation of the ideas for quality and for synthesis or incorporation into solutions.

Following these experiences, a specific systematic process for creative problem solving, in the form of a creative problem-solving model, was presented. The creative problem-solving model incorporates the higher-level thinking skills, as well as the various techniques previously introduced, into a step-by-step process which was applied in group or individual problem-solving situations. Students were encouraged to generate problems which had meaning for them and to apply the problem-solving model to effect a solution.

Areas of concern to which students applied creative problem-solving techniques were school problems, home problems, local and community problems, and national and international problems. Problems of the future were identified by several groups. A number of these problems led to areas of individual interest for independent study.

Stage III, the development and practice of independent study and research skills, was the major focus for the remainder of the school year. The skills developed in this component of the model were, for many gifted students, an acceleration of skills which could otherwise not be presented or practiced until later in their education. The skills equipped the gifted students to locate or create, organize, synthesize, and communicate their ideas and information. Gifted students have numerous and broad interests and need guidance in their efforts to pursue learning on their own. It was also important for these students to experience planning and sequential development through the culmination of a project. Many students were also ready to conduct original research of an experimental nature. Stage III guided students through experiences which met their individual needs.

The processes presented and the skills practiced were appropriate for the gifted and were organized sequentially and hierarchically, each stage building on the previous stage. Students in the experimental group were exposed to the Three-Stage Model for a period of six months. The six resource teachers were given extensive training and supervision in use of the model. There were about 12 students in each class.

## Analyses

In order to assess the effects of the program, three instruments were administered to students in the experimental and control groups at the end of the school year. Self-concept was measured by the Piers-Harris Children's Self-Concept Scale (Piers, 1969) and the ME Scale (Feldhusen & Kolloff, 1981). The Wallach-Kogan Creativity Instrument (Wallach & Kogan, 1965) was administered to assess the creative thinking abilities of the students. The total number of students for whom complete data were obtained was 392. The breakdown of students in the study is presented in Table 1. The independent variables in the study were treatment (experimental or control), sex, and grade level. The dependent variables were scores on the two self-concept scales, the Piers-Harris and the ME Scale; and four scores on the Wallach-Kogan Creativity Instrument: Verbal Fluency, Verbal Originality, Figural Fluency, and Figural Originality.

A multivariate analysis was used because this study was concerned with several aspects of the treatment, specifically, the self-concept and creative thinking outcomes. The multivariate analysis allowed consideration of the data in terms of whether differences existed between the students who participated in PACE and those who did not. Considering the data in this way initially reduced the number of possible statistical errors. The subsequent univariate analyses permitted inferences about the contribution of each criterion variable to the rejection of the multivariate null hypothesis (Finn & Mattsson, 1978).

The test of the multivariate hypothesis yielded a significant main effect for the Treatment factor. The F ratio, with 6 and 371 degrees of freedom, was 3.17. This result was significant beyond the .05 level. There were no significant two-way or three-way interactions in the multivariate analysis. However, an examination of the univariate results indicated a significant three-way interaction for verbal fluency which could affect the interpretability of the results. Thus, the variable was removed and analyzed separately. The reanalysis of the multivariate hypothesis yielded the same significant main effect for Treatment. The F ratio, with 5 and 372 degrees of freedom, was 3.59. This result was significant beyond the 0.5 level.

In order to determine the contribution of each criterion variable to the overall multivariate rejection, separate univariate analyses were conducted for the six criterion variables. These variables were the two measures of self-concept, the ME Scale and the Piers-Harris Children's Self-Concept Scale, and the four creative thinking variables, Verbal Fluency, Verbal Originality, Figural Fluency, and Figural Originality.

**Table 1**

Number of Students in the Study by Treatment Group, Grade, and Sex*

| | GRADE 3 | | GRADE 4 | | GRADE 5 | | GRADE 6 | |
|---|---|---|---|---|---|---|---|---|
| Experimental Group | (26)23 | (29)28 | (27)25 | (29)26 | (27)25 | (31)29 | (17)17 | (27)26 |
| Control Group | (28)26 | (22)21 | (26)26 | (25)24 | (26)24 | (32)31 | (16)15 | (30)26 |
| TOTALS | (54)49 | (51)49 | (53)51 | (54)50 | (53)49 | (63)60 | (33)32 | (57)52 |

| TOTALS | | |
|---|---|---|
| Experimental Group | (213) | 199 |
| Control Group | (205) | 193 |
| Grade 3 | (105) | 98 |
| Grade 4 | (107) | 101 |
| Grade 5 | (116) | 109 |
| Grade 6 | ( 90) | 84 |
| Boys | (193) | 181 |
| Girls | (225) | 211 |
| Grand Total | (418) | 392 |

*Parentheses indicate number of students initially selected for experimental or control groups.

## Results

### Self-Concept: The ME Scale and the Piers—Harris Children's Self-Concept Scale

The first two analyses examined the variables comprising self-concept. There was no significant main effect for Treatment. No significant two-way or three-way interactions were found for either dependent variable.

### Creative Thinking: Verbal Originality

Results of the univariate analysis of Verbal Originality indicated a significant main effect for Treatment. The F ratio was 13.53, with 1 and 372 degrees of freedom. These results are presented in Table 2. The mean for the students who participated in PACE was 13.02, while the mean for those who did not participate was 9.29. Standard deviations for these groups were 10.92 and 8.20.

Table 2
Analysis of Variance for Verbal Originality

| Source | df | MS | F | p |
|---|---|---|---|---|
| Grade | 3 | 979.73 | 11.40 | .001 |
| Sex | 1 | 534.43 | 6.22 | .01 |
| Treatment | 1 | 1163.19 | 13.53 | .001 |
| Grade × Sex | 3 | 46.48 | .54 | .65 |
| Grade × Treatment | 3 | 101.68 | 1.18 | .32 |
| Sex × Treatment | 1 | 70.40 | .82 | .37 |
| Grade × Sex × Treatment | 3 | 78.71 | .92 | .43 |

## Creative Thinking: Figural Fluency

A univariate analysis of Figural Fluency yielded no significant main effect for the Treatment factor. There were no significant two-way or three-way interactions for this variable.

## Creative Thinking: Figural Originality

Results of the univariate analysis for the variable Figural Originality indicated a significant main effect for the Treatment factor. The F ratio was 4.83, with 1 and 372 degrees of freedom. Table 3 contains the results of this analysis. The mean for students who participated in PACE was 12.24 and the mean for students not participating in the program was 9.84. Standard deviations for both groups were 12.54 and 9.07.

Table 3
Analysis of Variance for Figural Originality

| Source | df | MS | F | p |
|---|---|---|---|---|
| Grade | 3 | 956.15 | 8.62 | .001 |
| Sex | 1 | 1413.48 | 12.75 | .001 |
| Treatment | 1 | 535.96 | 4.83 | .03 |
| Grade × Sex | 3 | 54.30 | .50 | .69 |
| Grade × Treatment | 3 | 144.50 | 1.30 | .27 |
| Sex × Treatment | 1 | 283.86 | 2.56 | .11 |
| Grade × Sex × Treatment | 3 | 44.48 | .40 | .75 |

## Creative Thinking: Verbal Fluency

The univariate analysis of Verbal Fluency yielded a significant three-way interaction. The F ratio was 2.98 with 3 and 376 degrees of freedom. These results are presented in Table 4. Tests of simple effects were conducted to determine any significant differences between the experimental and control groups for each sex at each grade level. The critical value of t at the .05 level for a two-tailed test is 1.96. One t test was significant at this level. The difference between experimental (114.64) and control (81.13) group means for boys at grade 5 yielded a t value of 3.55.

**Table 4**

Analysis of Variance for Verbal Fluency

| Source | df | MS | F | p |
|---|---|---|---|---|
| Grade | 3 | 25004.24 | 22.90 | .001 |
| Sex | 1 | 14356.50 | 13.15 | .001 |
| Treatment | 1 | 4526.72 | 4.15 | .04 |
| Grade × Sex | 3 | 842.22 | .77 | .51 |
| Grade × Treatment | 3 | 1599.41 | 1.46 | .22 |
| Sex × Treatment | 1 | 198.88 | .18 | .67 |
| Grade × Sex × Treatment | 3 | 3254.95 | 2.98 | .03 |

## Discussion

This study examined the effects of an enrichment program, the Purdue Three-Stage Model, on the self-concepts and creative thinking abilities of gifted elementary students. The first two analyses examined the self-concept measures. There were no significant differences between PACE students and those who were not in PACE on either the ME Scale, a self-concept scale for gifted students, or the Piers-Harris Children's Self-Concept Scale. These results indicated that PACE did not change the self-concepts of participants in this program, lending support to the idea that enrichment programs for the gifted do not affect self-concept either positively or negatively.

The analyses of the creative thinking variables supported the effectiveness of the PACE program in increasing certain creative thinking abilities. The results demonstrated the significantly higher performance of students who were in the enrichment program on a measure of Verbal Originality. Results were significant for Verbal Originality across four grade levels of gifted students.

The second creative thinking variable which yielded significant results for PACE students was Figural Originality. The Figural Originality scores of students participating in PACE were significantly higher than those of students who were not in the enrichment program. This finding supports the effectiveness of PACE in increasing the ability of gifted students to respond to figural material in unique ways.

Analysis of Verbal Fluency resulted in a significant interaction for this variable. Results indicate that PACE most strongly affected the Verbal Fluency of fifth-grade boys in the experimental group. Their performance for this variable was significantly higher than those in the control group. There were inconsistent findings for other grade levels and treatment groups.

The results of the research confirm previous research on the effectiveness of creativity training, but in this case, particularly with gifted or highly able children. The results for self-concept indicate no changes and, therefore, may reduce fears that these children's self-concept would decline when they face comparisons with other highly able children in a special program. While some research has also shown self-concept gains among gifted children in special programs, such an effect was not anticipated in the design of the program.

Further research is needed to ascertain the effects of the Purdue Three-Stage model on children's independent study skills, on the development of motivation, and on the ability to carry out long-range problem-solving tasks. Attitudinal evidence gathered in this project was all positive in relation to these variables, but experimental evidence based on behavioral observations is needed to confirm these hypotheses.

## Conclusions

This study supported the effectiveness of an enrichment program based on the Purdue Three-Stage Model. The program, which emphasized creative thinking, creative problem solving, and independent study abilities, produced significant differences between groups of gifted students randomly assigned to either PACE or a control group. The two groups differed on two creative thinking variables, Verbal Originality and Figural Originality, with the students who participated achieving significantly higher scores. Verbal Fluency was significantly higher for fifth-grade boys who participated in PACE. Comparisons between the groups on two measures of self-concept revealed no significant differences. It may be concluded that the creative thinking abilities of gifted elementary students can be developed through a systematic program of enrichment experiences. Students in the program maintained their self-concepts indicating that PACE did not affect self-concepts adversely.

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# Guidelines for Grade Advancement of Precocious Children

*John F. Feldhusen, Theron B. Proctor and Kathryn N. Black*

A major educational need of gifted and talented youth, as for all students, is for instruction in the basic skill areas and the standard disciplines at a level and pace which challenges, but does not exceed, their potential. Feldhusen and Klausmeier (1961) conducted a series of experiments in which they demonstrated that when a new learning task is selected at just the right level of student readiness, the skill or concept is learned well and will be effectively remembered and generalized to other relevant problem situations. When a new task to be learned is too difficult, students are frustrated; when it is too easy, they are bored and lose interest in learning.

Most teachers do some individualization to meet children's skill and conceptual levels. Some teachers are renowned for a high degree of individualization and efforts to adapt instruction to a broad range of levels, while others keep all students in a lockstep at one common level. In general, therefore, a student's experience with individualized instruction may be haphazard from year to year. Furthermore, few teachers are able to individualize sufficiently to meet the needs of gifted and talented students. Many are limited by school policy which prohibits them from securing and using higher-level instructional materials. Additionally, teachers at higher grade levels sometimes complain that they will have nothing left to teach if teachers at lower grade levels cover the material.

The most appropriate educational provision for gifted and talented youth is a system of specifically designed classes which provide early learning activities at an appropriate pace and level and which emphasize the process skills of critical and creative thinking and research. Unfortunately, this type of educational provision is not yet available to most gifted and talented youth. However, one of the more readily available educational

**JOHN F. FELDHUSEN** is director of the Purdue Gifted Education Resource Institute. He is past president of the National Association for Gifted Children and a Fellow of the American Psychological Association.

**THERON B. PROCTOR**, a school psychologist, is currently a doctoral candidate specializing in gifted education in the Department of Psychological Sciences at Purdue University.

**KATHRYN N. BLACK** is a developmental psychologist in the Department of Psychological Sciences at Purdue University, where she is a consultant for the Gifted Education Resource Institute.

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alternatives for the intellectually or academically gifted student is grade advancement. While it is rarely the case that a student would be advanced to a level which fits his or her grade equivalent scores on achievement tests, advancement of a year or two often brings the child closer to an appropriate level of challenge and pace and into contact with more intellectually stimulating peers. While school personnel express great concern about possible social-emotional dangers in grade advancement, research indicates that the concern is usually unfounded, and that we should possibly be equally concerned about the social-emotional dangers of holding gifted students back in the lockstep of graded instruction.

Grade advancement studies are almost uniformly supportive of the procedure. A comprehensive review of the literature on grade advancement and its effects on children was undertaken by the authors and used as the basis for developing the guidelines presented in this article. Although space does not permit a discussion of those research reports, the entire bibliography is presented at the end of this article. These studies support the following generalizations: (a) There is no empirical basis for the belief that grade advancement will result in either social-emotional maladjustment or gaps in learning; (b) objective measures of educational performance and subjective measures of student and parent satisfaction suggest that grade advancement results in far more positive consequences than negative ones; (c) academically, it does not seem to matter which grade level the child does not directly experience. We conclude, therefore, that grade advancement could be used more frequently in meeting the needs of the intellectually or academically gifted student. To be most effective, grade advancement should be well planned and carefully evaluated. The major purpose of this paper is to present a practical set of guidelines for making grade advancement decisions.

We believe that grade advancement decisions should be based on a comprehensive individual assessment. An ideal response to a request for grade advancement would be to consider the following guidelines which have emerged from our experiences and our examination of the research literature.

1. There should be a comprehensive psychological evaluation of the child's intellectual functioning, academic skill levels, and social-emotional adjustment by a psychologist.

2. Intellectually, the child should have an IQ of 125 or higher or have a level of mental development above the mean for the grade he or she desires to enter.

3. Academically, the child should demonstrate skill levels above the mean of the grade desired. If the child is high in several skill levels but low in only one, the child may be advanced to the appropriate grade level if private tutoring is provided in the area of weakness. Conversely, some children's academic skill levels vary considerably. That is, they may be very far advanced in mathematics but just moderately above average in language arts or reading. For such children it may be best to keep them in grade but allow them to work with a higher grade only for the subject in which they are precocious.

4. Socially and emotionally, the child should be free of any serious adjustment problems. Additionally, the child should demonstrate a high degree of persistence and motivation for learning. However, in specific

cases there may be serious adjustment problems caused by inappropriately low grade placement. In such cases, the problem may be alleviated by grade advancement.

5. Physically, the child should be in good health. The child's size should be considered only to the extent that competitive sports may be considered important in later years.

6. The psychologist should determine that the child does not feel unduly pressured by the parents to advance. The parents must be in favor of grade advancement, but the child should express the desire to move ahead.

7. The receiving teacher or teachers must have positive attitudes toward the acceleration and be willing to help the child adjust to the new situation. If a receiving teacher is hostile or pessimistic, another receiving teacher should be located or the move should not be made.

8. Public school teachers are sometimes unduly pessimistic about children's social-emotional maturity. For a precocious child, they might often confuse a child's misbehavior which is caused by dissatisfaction with inappropriate instruction with immaturity. Judgments about a precocious child's maturity should therefore include input from parents and the psychologist.

9. Efforts are generally made to have grade advancement occur at natural transition points such as the beginning of a new school year. However, mid-year advancement may sometimes be desirable because the new teacher and the teacher the child is leaving may more easily confer about how best to help the child make a smooth transition. They should especially review the child's skill levels to make sure the receiving teacher is aware of any special needs or weaknesses.

10. All cases of grade advancement should be arranged on a trial basis. A trial period of six weeks should be sufficient. The child should be aware that if it does not go well he or she may request to be returned to the original grade. During the trial period, counseling services should be available to the child or teacher as needed.

11. Care should be exercised not to build up excessive expectations from grade advancement. The child should not be made to feel he or she is a failure if it does not go well. Alternatively, some precocious children are so advanced in their intellectual and academic skills that one year of advancement may still leave them bored in school. For a very few precocious children, additional advancements may be necessary.

12. Grade advancement decisions should be based on facts rather than myths. Examination of the research literature reveals that acceleration contributes to academic achievement. No negative effects on social or emotional development have been identified. If adjustment problems occur, they tend to be minor and temporary in nature. Conversely, failure to advance a precocious child may result in poor study habits, apathy, lack of motivation, and maladjustment.

Grade advancement is a method of acceleration which is available to every school system. For many school systems with limited resources, small student populations, or both, grade advancement may be the primary means available for adjusting the educational program to meet the educational and socio-emotional needs of gifted and talented youth. For school systems with gifted and talented programs, grade advancement should be one of the services available along with other options that may be offered.

Grade advancement should be considered as one legitimate and valuable method of meeting the needs of the intellectually or academically gifted. When practiced wisely, students have been found to maintain their interest in school, excel academically, and complete higher levels of education. Thus, grade advancement benefits not only the child but society as well.

The guidelines presented here are based on insights from the research reviewed and from our own experience as consultant psychologists in many cases of grade advancement decision-making. The guidelines can serve to make the decision-making process more systematic and reliable as an educational service for gifted and talented children.

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# Radical Acceleration in Australia*

*by Miraca Gross*

Ten-year-old Terence Tao of Adelaide, South Australia, is a prodigiously gifted young mathematician. Julian Stanley, Director of the Study of Mathematically Precocious Youth (SMPY) at Johns Hopkins University, states that Terry has the greatest mathematical reasoning ability he has found in 14 years of intensive searching (Stanley, 1985).

In May, 1983, at the age of 8 years 10 months, Terry took the Scholastic Aptitude Tests—Mathematics (SAT-M) at Stanley's invitation and made the phenomenal score of 760 out of a possible 800. Only 1 percent of college-bound 17- and 18-year-olds in the United States attain a score of 750 or more on the SAT-M and, so far as Stanley knows, to this date only one other 8-year-old has ever scored higher than 700.

In some ways it is ironical that such a profoundly gifted student as Terry should have appeared in Australia, an obsessively egalitarian society where social antipathy towards gifted children and towards those who would set up special programs for the gifted is a powerful deterrent to the establishment of state-mandated gifted programs. Two Australian states, Western Australia and Victoria, do provide structured accelerated programs for highly gifted secondary school students within the government system, but these programs are under intense criticism from the teachers' unions, the media and many politicians. Terry's state, South Australia, has no such program; the few cases of acceleration which have arisen have proceeded from the interest and concern of individual teachers and have received little or no support from the state education system.

Paradoxically, Terry's father, Dr. Billy Tao, a pediatrician, feels that in Terry's case the absence of a formalized structure may have been an advantage rather than a hindrance:

> My wife and I have been fortunate in having been able to work very closely, first with the principals and staffs of Terry's primary and secondary schools and later with the faculty of Flinders University, to design a highly individualized program which has been tied in to Terry's levels of ability in all subject areas, not only in maths and the sciences but also in the humanities. If South Australia had already had well established gifted programs, Terry might have been drawn into a less flexible system, quite different from what has actually eventuated. (B. Tao, 1985).

**MIRACA GROSS**, who is a teacher of the gifted in Adelaide, South Australia, is currently a Ph.D. candidate in gifted education at Purdue University. She is the 1987 recipient of the Hollingsworth Award for research in education and psychology of the gifted.

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Born in Adelaide on July 14, 1975, Terry is the eldest son of Billy and Grace Tao, the latter a first-class honors graduate in mathematics and physics, who met at the University of Hong Kong where both were educated before emigrating to Australia in 1972. Terry has two younger brothers, Trevor, 7, and Nigel, 5.

Terry's intellectual precocity displayed itself at an early age. In common with a number of other intellectually gifted children (Salzer, 1984), he taught himself to read by watching Sesame Street; the difference, however, is that Terry acquired this skill before the age of 2. His reading came as a complete surprise to his parents; they found him playing with another child's alphabet blocks, arranging the letters in alphabetical order. Some of the blocks had numbers, and the Taos discovered that Terry could arrange these in numerical order and, shortly afterwards, do simple addition and subtraction.

A few months after Terry's second birthday, the Taos found him using a typewriter which stood in Dr. Tao's office; he had copied a whole page of a children's book laboriously with one finger! At this stage his parents decided that, although they did not want to "push" their brilliant son, it would be foolish to hold him back. They began to borrow and buy books for him and, indeed, found it hard to keep pace with the boy. They encouraged Terry to read and explore but were careful not to introduce him to highly abstract subjects, believing, rather, that their task was to help him develop basic literacy and numerical skills so that he would learn from books by himself and thus develop at his own rate.

"Looking back," says Dr. Tao, "we are sure that it was this capacity for individual learning which helped Terry to progress so fast without ever becoming bogged down by the inability to find a suitable tutor at a crucial time." By the age of 3, Terry was displaying the reading, writing and mathematical ability of a 6-year-old.

The Tao parents feel that the single most important event in Terry's education was, ironically, the "failure" of his attempt at early entrance into formal school:

> We were so carried away by the speed of Terry's progress between the ages of 2 and 3½ that we took the rather naive and simplistic view that everything would be very easy and rosy and that if we sent Terry to school early the school would do whatever was necessary to meet his needs, and he would be able to continue to develop at his own pace (B. Tao, 1985).

Terry entered a private (independent) primary school in February, 1979 (the Australian school year runs from February to December) at the age of 3 years, 6 months. This particular form of acceleration did not, however, meet Terry's very specific needs. Intellectually, he was far in advance of the 5-year-olds in his class. Socially, however, he was not yet ready to spend extended periods of time with children two years older than himself. His teacher could not cope with the situation and explained that Terry distracted the other students. After several weeks his parents and educators came to a mutual decision that Terry be withdrawn from school. The Taos entered him in a neighborhood kindergarten with children of his own chronological age.

Numerous studies (e.g., Worcester, 1955; Hobson, 1979; Alexander and Skinner, 1980) have shown that where underage children are admitted to formal schooling on the basis of intellectual and academic precocity and social readiness, they perform as well as, or rather better than, their older classmates. However, the majority of the children studied have been within 12 months of the usual minimum date of admission to school, and emotional maturity is recognized as being an important prerequisite for the children's social and academic success (Reynolds, Birch, & Tuseth, 1962).

The Taos believe they learned several important lessons from this early experience:

> Firstly we realized that no matter how advanced a child's intellectual development, he is not ready for formal schooling until he has reached a certain level of maturity, and it is folly to try to expose him to this type of education before he has reached that stage. This experience has made us monitor Terry's educational progress very carefully. Certainly, he has been radically accelerated, but we have been careful to ensure, at each stage, that he is both ready and eager to move on, and that we are not exposing him to social experiences which could be harmful.
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> Secondly, we have become aware that it is not enough for a school to have a fine reputation and even a principal who is perceptive and supportive of gifted education. The teacher who actually works with the gifted students must be a very flexible type of person who can facilitate and guide the gifted child's development and who will herself model creative thinking and the love of intellectual activity.
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> Also, and possibly most importantly, we learned that education cannot be the responsibility of the school alone. Probably for most children, but certainly for the highly gifted, the educational program should be designed by the teachers and parents working together, sharing their knowledge of the child's intellectual growth, his social and emotional development, his relationships with family and friends, his particular needs and interests...that is, all the aspects of his cognitive and affective development. This did not happen during Terry's first school experience but I am convinced that the subsequent success of his academic program from the age of 5 onwards has been largely due to the quality of the relationships my wife and I have had with his teachers and mentors (B. Tao, 1985).

During the 18 months Terry spent in kindergarten, his mathematical ability progressed at a phenomenal pace. Guided by his mother, Grace, he completed almost all the elementary school math curriculum (normally seven years' work) before the age of 5. One of Terry's early mentors, a professor in mathematics education at Monash University, has described Grace Tao's role as more one of guiding and stimulating Terry's development than one of teaching him.

"She said that while she sometimes attempts to guide Terry's mathematical learning, she doesn't help him much because he 'doesn't like to be told what to do in mathematics'" (Clements, 1984). Most of Terry's learning was acquired through his voracious reading of mathematics and mathematics textbooks.

## Involvement with SAAGTC

During this kindergarten period the Taos began reading books concerning the education of gifted children and joined the South Australia Association for Gifted and Talented Children (SAAGTC), a group of teachers and parents of gifted students who run Saturday programs for gifted children and seminars and workshops for parents and teachers. Here, for the first time, Terry was able to work and socialize with other highly gifted children. Although he met no one sharing his own prodigious math ability (this is not surprising because in terms of IQ alone he is, statistically, one in a million and the entire population of Australia is less than 16 million), he was able to mix with other children who shared his hunger for information, his ability to assimilate and integrate abstract concepts, and his delight in creative exploration. Even within the accelerated context of SAAGTC programs, however, it was found necessary to accelerate Terry still further beyond his gifted age-mates. I vividly recall one of my first meetings with Terry when, in my capacity as President of SAAGTC, I was informally assessing his mathematical ability for placement in SAAGTC programs. At just under 4, he was multiplying two-digit numbers by two-digit numbers in his head while I, the 'tester,' required pen and paper to check his answers! Another image springs to mind of Terry, one month before his fifth birthday, working with a group of gifted 7-to-9-year-olds at an SAAGTC math workshop. The teacher challenged the students to find the next four numbers in the sequence 9182736. Terry thought briefly and responded, "4554." He was, of course, correct. The number sequence consists of selective multiples of 9.

Dr. Tao also benefited from his experiences with SAAGTC:

> Listening to the parents of other gifted children is a good way to learn. I have noticed that books on gifted education have not emphasized this in a prominent way. For myself, I found it beneficial to learn about other parents' ups and downs both in parenting and schooling of their gifted children. Of equal importance, I learned what is an acceptable "parent-manner" to other people. Occasionally I would see a parent who seemed to me to be arrogant or pushy in speaking about her gifted child and then I realized, to my dismay, that I was probably perceived in just that way by other people when I spoke about Terry! Meeting with these other parents helped me to grow up and become more acceptable to others, and I have been very careful, during Terry's subsequent education, to guard against the appearance of being overly proud of him. Actually, I don't think his mother and I are overly proud of his abilities but society expects parents of gifted children to be so, so that we have to be extra careful not to give that impression (B. Tao, 1985).

## Primary/Secondary Education

During this period, through reading and talking with educators, Grace and Billy Tao developed the concept of a form of scholastic program which would meet Terry's intellectual and social needs. Although his performance in most subject areas was far above the level of his chronological age, he was not, nevertheless, uniformly advanced across the board. His prodigious mathematical ability was some years in advance of his language ability. They conceived a structure whereby Terry would "ride" several class levels at one time, taking each school subject at a grade level appropriate to his ability. This structure would have the added advantage of permitting him to mix with children of all ages and ability levels as he progressed through school.

His parents investigated a number of local schools, seeking one with a principal who would have the necessary flexibility and openmindedness to accept Terry within the program structure they had in mind. After meeting on a number of occasions with the principal, they enrolled Terry, two months after his fifth birthday, in Bellevue Heights Primary School, a public school some two miles from their home. (Five is the usual age for school entry in South Australia, and children customarily enter on the first day of the term after their fifth birthday.) After a brief period of time during which Principal Keith Lomax and staff could assess his performance both academically and socially, he was promoted to a split-grade class where he did most of his work with the Grade 2 students except for mathematics, which he undertook with Grade 5.

This set the pattern for the "integrated" multi-grade acceleration program which his parents had envisioned and which was adopted, after much thought and discussion, by the school. By early 1982, when Terry was 6 years, 6 months old, he was attending grades 3, 4, 6 and 7 for different subjects. On his way through school, he was able to work and socialize with children at each grade level and, because he was progressing at his own pace in each subject, without formal "grade-skipping," gaps in his subject knowledge were avoided.

At home, Terry continued his advanced study in mathematics. By the age of 6, having taught himself BASIC language by reading a manual, he had written several computer programs on mathematics problems. He is a lively, creative child with a puckish sense of humor; something of his personality comes over in the introduction to his "Fibonacci" program, which is quoted in full by Clements (1984).

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 8 print "J" (This symbol means "clear the screen")
10 print "here comes mr. fibonacci"
20 print "can you guess which year was mr. fibonacci born?"
30 print "write down a number please...":input c
31 if c =  1170 then print "you are correct; now we start!: go to 150
50 if c>1250 then print "no, he is already in heaven; try again:" go to 30
60 if c<1170 then print "sorry, he wasn't born yet!; try again": go to 30
70 if c>1170<1250 then print "he would be c-1170 years old."
71 print "now can you guess?"
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The program goes on to produce all the Fibonacci numbers up to the level requested by the player.

At the age of 8 years, 3 months Terry achieved his first publication, a BASIC program to calculate perfect numbers (T. Tao, 1983).

By the time Terry had reached the age of 7 he had far outpaced the Grade 7 students in mathematics and was working independently on Grade 10 math at home, in the evenings. It soon became clear to the principal that Terry needed the opportunity to work at his true mathematical level with other students. After discussing the situation with Grace and Billy, he successfully undertook the task of persuading the principal of the nearby high school to take him part time in a continuation of his integrated program. So, at the age of 7 years, 6 months Terry commenced his study at high school for one or two classes per day, the balance of his time being spent at his primary school. By third term, 1983, when he was 8 years, 2 months old, his progress at Blackwood High covered math 1 and 2 with Grade 12 students, physics with Grade 11, and English and social studies with Grade 8, while for the rest of the week he took other subjects at primary level with Grade 5 and 6 students. The Taos insisted that Terry remain part time at primary school to provide socialization with children nearer his age.

Terry adapted to Blackwood High, and Blackwood High to Terry, with little difficulty. John Fidge, his Grade 11 math teacher, found that after the strangeness of his first two weeks he was accepted as just another member of the class and regarded as a friendly, well adjusted, helpful and good-natured lad by his classmates (Clements, 1984). This, when one considers that Terry was, even at this early stage, finishing his work two lessons before his 16-year-old classmates, says much for his social skills. He is a delightful young boy who is aware that he is different but displays no conceit about his remarkable gifts and has an unusual ability to relate to a wide range of people, from children younger than himself to the university faculty members with whom he now works. Billy Tao believes that the two years of "riding" several classes each term at primary school laid the groundwork for his being able to cope with much older students later.

An important factor in Terry's happy assimilation into high school was that, because of his extreme youth, he was not seen as a threat, either intellectually or socially, by the 16- and 17-year-olds with whom he worked. He was visibly not in competition with them for jobs, scholarships or boy-girl friendships; paradoxically, this allowed him to be treated as just another member of the class, with the very occasional privilege of getting a piggy-back ride from teacher during bush-walking excursions!

"I am now convinced," says Dr. Tao, "that it is in fact easier to integrate a highly gifted child into a higher grade in secondary school than a lower grade and Terry was lucky that he started math in Grade 11 instead of Grade 8."

## Secondary/Tertiary Education

In November of 1983, at the age of 8 years, 3 months, Terry informally took the South Australian Matriculation (university entrance) examination in Mathematics 1 and 2 and passed with scores of 90 percent and 85 percent, respectively. In February the following year, on the advice of both his primary and secondary teachers, who felt he was emotionally as well as academically ready, the Taos agreed that he should begin to attend high school fulltime. He was based in Grade 8 so he could be with friends with whom he had undertaken some Grade 7 work the year before, and at this level he took English, French, general studies, art, and physical education. Continuing his integration pattern, however, he also studied Grade 12 physics, Grade 11 chemistry, and Grade 10 geography. He also began studying first-year university mathematics initially by himself and then, after a few months, with help from a professor of mathematics at the nearby Flinders University of South Australia. In September that year he began to attend tutorials in first-year physics at the university, and two months later he passed university entrance physics with a score in the upper 90s. In the same month, finding that he had some time on his hands after the matriculation and internal exams, he started Latin at high school.

In early 1985, a few months before his 10th birthday, Terry was spending one-third of his time at Flinders University taking second-year math and first-year physics. The rest of his time was, and is, spent at high school working in Grade 12 chemistry, Grade 11 geography and Latin (after only nine months' study of the language!), Grade 10 French, and Grade 9 English and social studies. In November, 1985, he took the university entrance chemistry examination to begin first-year chemistry at Flinders in February, 1986.

## Full-Time University Entrance...When?

The question now before the family is: What direction should Terry take? There is little doubt that, if he chose to enter university full-time, he would graduate in mathematics before his 12th birthday. (He would, incidentally, become the youngest person ever to do so; currently, the youngest graduate is Jay Luo who took a degree at Boise State University, Idaho, at the age of 12 years 42 days). Terry's IQ has been assessed as between 220 and 230, and he has no areas of academic weakness. Even in English and social studies, which he considers his weaker subjects, he is working at a level four years above his chronological age.

A number of factors have influenced the Tao family's thinking about Terry's future study. In September, 1984, at the age of 9, he was invited, with a small group of senior high school students, to compete in an Australia-wide math competition to choose candidates to participate in the Australian Mathematical Olympiad. Despite being the youngest candidate by a margin of five years, he top-scored in South Australia and ranked sixth place nationally. However, in the Australian Mathematical Olympiad, which was held six months later, he lost his sixth place and consequently was not selected for the Australian team which competed in the International Mathematical Olympiad in Finland in July, 1985.

The Taos feel there is an important message in this result.

"Terry's development in maths has been so fast," says Dr. Tao, "that like rapidly growing grass in fine weather, he has not had time to put down deep roots. When he was faced with really challenging work at a level he had not encountered before, that was when the weakness showed up. However, it is much kinder to Terry," he adds, "for him to 'fail' within his own state rather than at the International Olympiad where he would have attracted a lot of attention, even among the other competitors, because of his extreme youth."

In May, 1985, at the invitation of Julian Stanley, director of the Search for Mathematically Precocious Youth at Johns Hopkins University, Terry and his parents spent three weeks in the United States, visiting a number of university campuses, including Johns Hopkins, Purdue, Columbia, Princeton, Berkeley, and Stanford, and talking with experts in mathematics and gifted education. This experience, the Taos say, has helped to clarify their thinking on Terry's future education.

Terry's parents now feel that he should probably wait at least three more years before he enters university full-time.

"In three years he will be 13," says Billy Tao:

> There is no need for him to rush ahead now. If he were to enter full-time now, just for the sake of being the youngest child to graduate, or indeed for the sake of doing anything "first," that would simply be a stunt. Much more important is the opportunity to consolidate his education, to build a broader base.
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> It is important for Terry to have a broad initial education. I can see two different models of how his education could progress. The first is what a might call a "columnar" model, where his acceleration would be directed vertically upwards in math and physics with little expansion into other areas of knowledge. The problem here is that, although progress may be fast and easy at the beginning, as the column gets taller it becomes more difficult to build on further knowledge and, to continue the metaphor, the taller the structure grows, the shakier it may become. The other model, which we have selected, is pyramidal in shape, where Terry's work in mathematics and the sciences is integrated with many other areas of knowledge. Initial progress may be slowed down while he explores the relationships between all these areas of study, but as the pyramid gains height it becomes easier and faster and the whole structure rests on a sound base of interrelated knowledge.
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> This broad base of knowledge is essential. At the highest level of any subject the boundary between science and arts, between mathematics and philosophy, becomes less and less distinct. You cannot enter this highest level of sophistication if you are too specialized. Even in pure mathematics there will be many problems which you cannot answer simply by applying mathematical techniques. Take Einstein and the theory of relativity, for example; it is not so much mathematics as concepts beyond computation.
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> If Terry entered university now he would certainly be able to handle the work but he would have little time to indulge in original exploration. Attending part time, as he is now, he can progress at a more leisurely rate and more emphasis can be placed on creativity, original thinking, and broader knowledge. Later, when he does enter full time, he will have much more time for research or anything else he finds interesting. He may be a few years older when he graduates but he will be much better prepared for the more rigorous graduate and post-doctoral work.
>
> It is easy to label a child a prodigy, but not all prodigies achieve genius. Genius is not related to speed of development. It requires qualities of creative thought and exploration…the ability to break through and make a unique or original contribution (B. Tao, 1985).

Another factor in the Taos' decision is their on-going concern for Terry's social development:

> University is not the best place for a young child to mature socially, certainly not before adolescence. By continuing to spend part of his time in high school Terry can continue to make friends nearer his own age, learn to sort out the priorities of life, establish a more mature self-perception and generally cope with the realities of the world (B. Tao, 1985).

## Home Environment Research on Highly Gifted Children

Terry Tao has been extremely fortunate in his home environment. Both Terry's upbringing and the relationships within the Tao family reflect many positive characteristics of the families of highly gifted children studied by Hollingworth (1942), Witty (1940), Goertzel and Goertzel (1962) and Bloom (1985). These include a deep love of learning for its own sake within the family, a valuing of intellectual achievement, a modeling by both parents of a persistent drive towards goals and a warm acceptance of the gifted child for his own sake, not merely for his accomplishments. Interestingly, Terry's home, where parents and children enjoy each other's company and share a very visible and deep affection, where the children are given considerable intellectual freedom and where there is a definite but not oppressive code of family ethics, is highly characteristic of the "trouble-free" homes which produced the scientists and physicians of the Goertzels' study.

Up to the present time there has been little research into the part played by parents in the education of profoundly gifted children. Much of what has been written has centered on the exploitative tendencies displayed by what Montour (1977) terms "creator parents." These parents of young prodigies such as economist John Stuart Mill (Mill, 1924; Packe, 1954), mathematician William James Sidis, Norbert Wiener (1953), Edith Stern (1953) and the remarkable family of Welsh children described by Deakin (1972) reject the idea that superior ability may be innate and believe that their children's genius is uniquely a function of the educational program they have designed and supervised. As Montour notes, this egocentric belief is often accompanied by an eccentric social or educational ideology that the parent attempts to express through exhibiting the child.

There is little doubt that creator parents comprise an extremely small minority among parents of profoundly gifted children; they are, however, highly visible because of their compulsive publicizing of their child's genius. More research needs to be undertaken on what I would call "nurturant parents" such as the Taos who become keenly involved in the design and development of their profoundly gifted child's scholastic program but who see their role as guides and facilitators, rather than originators, of their child's exceptional abilities.

## Terry's Affective Development

Professor Miriam Goldberg, in her visits to Australia on behalf of the Australian Commonwealth Schools Commission, noted that "the spectre of elitism which haunts Australian educators" is accompanied by the peculiarly Australian belief that the ability to "get along" with everybody is of major importance in childhood and the resultant concern that "any school procedures which single children out as being more able than the generality may jeopardize their sense of identity with and acceptance by the 'common man'" (Goldberg, 1981).

In this educational and social climate, programs such as Terry's evoke distrust, even hostility, not least from within the educational community.

Most of the criticism, of course, stems from teachers who have never met or worked with Terry and who, indeed, have never spoken with any of the teachers involved in his education. Those teachers who have worked with him quickly realize the absurdity of the suggestion that he should spend all or even most of his time with children of his own chronological age; the general view, however, is that he should be "left alone to be just a normal kid." Terry's parents and teachers would endorse Feldhusen's view (Feldhusen, 1983) that forcing a highly gifted student to be like an average child is forcing him or her to be abnormal—or indeed, subnormal!

Despite such an unfavorable social climate, Terry as an individual is almost universally liked and admired by the teachers and students with whom he works. Having had the opportunity to study the development of his personality over the last six years, I am sure that this warmth and acceptance are largely due to the gentleness and modesty of Terry's nature. He is able to talk frankly and confidently to strangers as well as friends, but displays no arrogance or conceit. His parents have taught him not to posture but, at the same time, not to conceal his ability. Unlike most profoundly gifted children, he seems to have no difficulty in relating to people of lesser ability (Hollingworth, 1942). He has no conception of himself as "better" than others, merely different. To Terry everyone is of value; everyone has something to contribute.

Terry's motivation to excel, to discover and to create is a burning force in his life. The results of his endeavors—the award, the prize, or whatever—are of much less importance to him than the delight of intellectual speculation. Billy Tao tells of Terry's reaction to the news that he had achieved the highest score Stanley had ever found for a child of his age on the SAT-M:

> I asked him what he would like as a reward and he probably thought that was a more difficult question than the SAT itself! After a few seconds he asked for a piece of chocolate which had been in the refrigerator for some time and was almost forgotten. When I gave it to him he broke it into two halves and gave one to me. He was delighted with the result, or course, but there was no great celebration or anything like that. He was more interested in going back to the physics book he was reading (B. Tao, 1985).

Terry's capacity to analyze and comment on his own intellectual growth and development is surprising in one so young. During his visit to Purdue University he spoke to the faculty and graduate staff of the Gifted Education Resource Institute about his early experiences:

> A couple of years ago I sat for a statewide math competition for the first time. I was given two hours to do it but I finished in 20 minutes and spent the remaining time devising a method to find the value of pi. Afterwards, when Mum found out what I had done and asked me why I didn't spend more time on the competition and check my answers, I just said, 'Wait till I get a prize!' Needless to say, I didn't get any prize and I was quite depressed for awhile. Dad later discovered that most of my wrong answers were due to arithmetical errors. After that episode, I learned that I should always time myself during an exam and check my work. Unfortunately, I still don't attend to the latter very well!
>
> I discovered I could learn better and remember more if I taught my broth-

> ers what I had learned. So I taught one brother chess and the other music. My music has never been very good—in fact, I hated it until I gave myself the motivation to teach Trevor. Now I actually quite enjoy playing duets with him. I spent a lot of my spare time working out interesting ways to teach them, and I probably learned more from teaching them than they did from me (T. Tao, 1985)!

Terry's educational program contains five elements which Van Tassel-Baska identifies as essential elements of a successful gifted program (Van Tassel-Baska, 1985): content acceleration to the level of the child's abilities; thoughtfully planned, relevant enrichment; guidance in selecting courses and directions; special instruction with the opportunity to work closely with other gifted youth; and the opportunity to work with mentors who have high-level expertise in the child's area of giftedness. It will be interesting to have Terry's reaction to his unique "integrated acceleration" program in a few years' time. A SMPY survey of 21 mathematically precocious boys who had been radically accelerated found that, in comparison with equally talented youths who had not been accelerated, the accelerants had higher educational aspirations, believed that they had used their educational opportunities more effectively and felt that their educational program had had markedly positive effects on their social and emotional development (Pollins, 1983).

In Australia as well as in the United States, teachers and parents argue against acceleration of gifted children on the grounds that the child's social and emotional development may be jeopardized. In fact, reviewers who have examined this issue (Daurio, 1979; Gallagher, 1975; Robinson, 1983) find no evidence to support the notion that socio-emotional problems arise through well-run acceleration programs and suggest that we should concern ourselves rather with the maladjusting effects that can arise from inadequate intellectual challenge. To quote one gifted teenager writing in the American Association for Gifted Children's book *On Being Gifted*: "You can always catch up socially, but if a talent is dormant too long it may deteriorate."

Terry Tao has at all times been closely involved in the planning of his educational program. He recognizes the need to broaden the range of his knowledge by exploring further into the humanities and languages, while at the same time putting down deeper roots in mathematics and physical sciences, areas in which his achievements are already quite breathtaking. Recently he handed his father the following quotation, which he had discovered in Tolkein's *Lord of the Rings*.

> All that is gold does not glitter;
> Nor all those who wander are lost;
> The old that is strong does not wither;
> Deep roots are not touched by the frost.

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# Update on Terry Tao

The article reprinted from G/C/T was written in early 1986. Since that time Terry Tao has competed in three International Mathematical Olympiads as a member of the Australian team. In each instance he was more than four years younger than even the youngest of his teammates!

In July 1986, at the age of 10, Terry won a bronze medal at the International Mathematical Olympiad in Warsaw, Poland. The following year, when Terry was 11, the I.M.O. competition was held in Cuba and here Terry won a silver medal with the remarkable score of 40 points out of a possible 42.

On the first day of the Cuba I.M.O., Terry completed a paper which normally takes $4^1/_2$ hours in just under 2, achieving a perfect score. Whereas normally a competitor's scores are checked by two judges, the international adjudicators were turning up in groups of four and five to assess Terry's results and to see him work. Some of his answers were half a page shorter than the set responses and his solutions were different, but correct. He is by far the youngest silver medalist in the history of the I.M.O.

This year's International Mathematical Olympiad was held in Canberra, Australia. Terry, then 12, was again a member of the Australian team, and this time won a gold medal. Out of 300 students competing, Terry placed 13th. He was the youngest competitor by four years, and the only Australian to win a gold medal. When I talked with Terry before the competition, he was not particularly excited or anxious about winning; what was exciting him tremendously was the prospect of pitting his wits once more against the challenging content of the Olympiad papers. In response to complaints about the large number of gold medal winners last year, the level of difficulty was increased this year. After winning his medal, Terry said, "The level of difficulty was so great it was almost too difficult to be enjoyable." That was the first time I'd heard him make such a statement.

Terry's program of radical acceleration continues to meet his intellectual, academic and social needs. Currently, his studies at Flinders University of South Australia include third-year and fourth-year algebra and second year physics and computer science. At this school, which he still attends part-time, he takes Year 12 (final year) biology and Latin, Year 11 English, Year 8 German and a number of supplementary subjects.

Last April, at the age of 12 years 9 months, Terry re-sat the SAT-Verbal, achieving a score of 590, over 200 points higher than the score he achieved in 1985. Only 10 percent of college-bound male high school seniors in the United States score at this level. Dr. Julian Stanley considers that if his verbal skills continue to develop at this pace, he will achieve the average SAT-V scores for Harvard University freshmen by the time he reaches 14. There is little point in testing him again on the SAT-M; he would have hit the ceiling of this test before his 10th birthday.

Miraca Gross

# Mensa Education and Research Foundation: What Is It? And Why Is It?

*More and larger scholarships. More support for our gifted children programs. More support for research into the nature and uses of intelligence. More frequent colloquia. . .*

These goals are a recurring theme in surveys, local group newsletters, and conversations with Mensa members across the country. All evidence a desire for Mensa to be more than just a social organization—for Mensa to really contribute to the improvement of the society in which we live. In fact, many members joined Mensa expecting to participate in such activities.

MERF, which some like to consider the serious side of Mensa, has for many years handled Mensa's educational and philanthropic programs, but it hasn't always been very visible. Now MERF is changing and becoming a much more active presence,within Mensa.

Last year MERF awarded 57 scholarships, raised the value of the prizes awarded under our program for recognizing excellence in published research, provided assistance to the Gifted Children Program, and began an endowment development program that will secure and stabilize MERF's long-term future.

Essentially, MERF is a philanthropic, non-profit, tax-exempt organization whose purpose is to encourage research in the nature, characteristics and uses of intelligence.

Programs of MERF are funded primarily by tax-deductible gifts from members and friends of Mensa who are concerned with helping MERF continue its important work.

MERF's Scholarship Committee currently awards $28,000 annually in scholarships to 67 students nationwide. More than 5,000 students apply for the awards, which range from $200 to $1,000, and which are awarded solely on the basis of a competitive essay. Applicants must be enrolled in degree-granting programs at accredited American colleges and universities. Scholarship awards are not limited to Mensa members.

Several awards each year are made from endowed funds. These include the nine Grosswirth-Salny Scholarships, the Peter Booras Scholarship (to a student pursuing a teaching career), the Carol Gomez Scholarship (to a student in the Delaware Valley Mensa area), the Rita Levine Scholarship (to a woman who re-enters academic study after a period of employment or family management), and the Howard Turney Award (for study in engineering, mathematics, medicine or the physical sciences).

Intelligence—how we achieve it and what we do with it—is the realm of the Mensa Research Journal. The Journal publishes scholarly articles, most of which have won Awards of Excellence presented by MERF to researchers throughout the world, and the proceedings of the Mensa Colloquia.

Recent topics include a theory to explain why Asians score so well on intelligence tests; gender differences in SAT scores; what has happened to students who entered college at an early age; the correlation between giftedness, myopia and allergies; and selected papers from Colloquium III, the Impact of the Arts on Civilization.

In conjunction with American Mensa, MERF sponsors weekend-long Colloquia on serious issues. Authorities are invited to address those who participate; they, in turn, meet in informal, structured groups to further explore these issues. Colloquium IV will be held in October in Austin, Texas. The theme is "Science and Society: The Human Connection." Themes for prior Colloquia have been: The Impact of the Arts on Civilization (1986), The Gifted in Society (1984) and Forecasting a Valid Tomorrow (1982).

MERF encourages and supports research in the social and psychological sciences, especially projects that concern the intellectually gifted, including: measurement of upper levels of intelligence; psycho-social adjustment; identification of cultural differences; educational strategies; neurophysiological attributes of giftedness.

# Call for Papers
# Call for Books

The Mensa Education and Research Foundation encourages giftedness research through the Mensa Awards for Excellence for published articles and papers. In conjunction with Wright State University in Ohio, MERF also makes a Meritorious Publication Award when a suitable complete dissertation, book, or similar project is presented.

Many of the winners of the Awards for Excellence are printed in the Mensa Research Journal. To be eligible for these awards, the article or paper must have previously appeared in a journal or been presented at a scholarly or professional conference; or have been accepted for such publication or presentation. Subjects should be related to intelligence, particularly among the gifted. They might include

- measurement of upper levels of intelligence
- psychosocial adjustment
- identification of cultural differences
- educational strategies
- neurophysiological attributes of giftedness
- artificial intelligence.

Information about the Awards for Excellence or the Meritorious Publication Award is available from Dr. Joan E. Bauman, 4636 Candleglow Dr., St. Louis, MO 63129.

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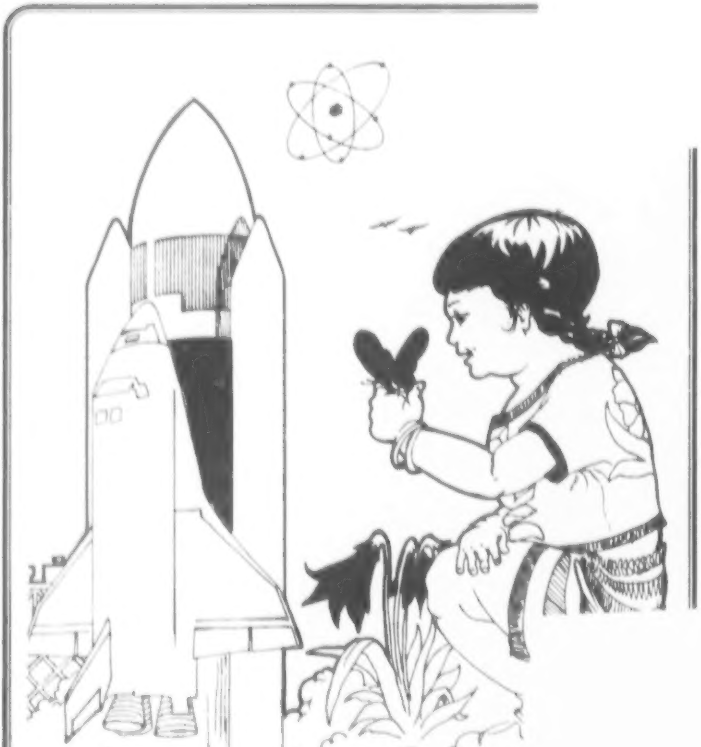

## PROCEEDINGS OF COLLOQUIUM IV

## SCIENCE AND SOCIETY: Our Critical Challenges

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# MENSA 26
## RESEARCH JOURNAL

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**Staff:**

*Editor* • Phyllis Miller, 23 Lexington Road, Somerset, NJ 08873

*Assistant Editor* • Mary Hollifield, 1104 Mary Lane, Fort Oglethorpe, GA 30742

*Circulation Manager* • Karolyn Silliman, 19340 Dunbridge Way, Gaithersburg, MD 20879

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# Editor's Preface

Thirty-five million people in America have no health insurance. Forty-seven percent can't figure out the area of a 4 × 6 rectangle. Out of 3400 Ph.Ds in engineering granted by American colleges in 1987, 139 went to women, 14 to blacks, and 1800 to foreign nationals. Our country is 19th in the world in the rate of infant mortality. We produce 25 pounds of garbage per week per person.

These were some of the figures I heard at the Mensa Colloquium in Austin, Texas last fall. They did not make me happy, nor were they calculated to do so. They did make me think, and they were calculated to do that. Among all of the above statistics, there must be at least one that shocks you, one that says to you, "What are we doing wrong? And how can we start doing it right?"

That was what the Colloquium was all about, and while those who attended could not overnight change those statistics, they did start thinking about them, and talking about them, and worrying about them.

Mary Carter, one of the guest speakers, said, "We have the capacity to create the problems; we have the capacity to advance the solutions." The Friday night keynote address by Phil Lane set the tone: let's look within ourselves. Let's not say the government will take care of it, or science will find a way, or who cares; let's look within ourselves. After Saturday morning talks by Dr. Carter, Sue Kemnitzer and Kevin O'Rourke, on three different aspects of the problems we face, the audience broke into small groups to talk, to listen, and most important, to think and to take responsibility.

When we convened Sunday to hear a wrapup of suggestions made by the groups, we found that although there were three different aspects, and many small groups within those three, all groups emphasized personal responsibility. As Gabe Werba noted, intelligence not used for the benefit of society may be a moral failure, and the groups felt very strongly that individual involvement and responsibility are the keys to meeting society's critical challenges.

This issue of the *Mensa Research Journal* is devoted to the Proceedings of that Colloquium, including the four talks by Phil Lane, Kevin O'Rourke, Mary Carter and Sue Kemnitzer, and the opening and closing addresses by Gabe Werba. From the opening "Good evening, ladies and gentlemen" to the closing "go forth, enjoy—and think," it's all first-rate.

Also first-rate is a new feature of the MRJ, a column called By Invitation Only. From time to time I will invite someone I know to write about a topic of particular interest. For this first one, Kathleen Spaltro, publications chairman for the MERF Board, writes about the special problems of the hearing-impaired gifted from a special viewpoint.

I am especially indebted to Pat Merck and Mary Prior of San Antonio Mensa for their efforts in bringing these Proceedings together.

Phyllis Miller
Editor

# Letters

**To the Editor:**

Beverly Halstead is right in stating that the general theory of r/K strategies is that populations with abundant food supplies tend to adopt r strategies of having large numbers of offspring to which they devote little attention. The reason is that where there are plentiful food supplies the offspring can fend for themselves. When early men migrated into Europe and Asia they would have encountered just such an environment, for there were plenty of herbivores providing an excellent source of food once the hunting skills for catching them had been perfected. Hence early Caucasoids and Mongoloids would have adopted our strategies.

This presents some difficulty to J. P. Rushton's theory that Caucasoids and Mongoloids are less r and therefore more K than Negroids. To salvage Rushton's theory it is necessary to suppose that the periodic ice ages changed the Northern hemisphere from being a benign environment into an exceptionally harsh one. This would have brought about a shift to K strategies, especially in the Mongoloids for whom the environment during the successive ice ages was more severe than for the Caucasoids. In Asia north of the Himalayas January temperatures in the last ice ages were around -20C and it would have been difficult to ensure the survival of more than one infant. The severity of conditions in the ice ages reconciles J. P. Rushton's evidence for high K in Mongoloids with the points validly made by Beverly Halstead.

Richard Lynn
University of Ulster at Coleraine
County Londonderry BT52 1SA
Northern Ireland

---

**To the Editor:**

Beverly Halstead claims (MRJ, 25) that my ordering of Mongoloids 〉 Caucasoids 〉 Negroids in K reproductive strategy (MRJ, 24, 30–32) is "singularly inappropriate and wildly simplistic." His own letter, however, contains data in support of my argument although it seems otherwise to obfuscate several issues.

Halstead cites genetic distance measures showing that Homo sapiens evolved in Africa and subsequently migrated northwards to other parts of the globe, with a Negroid-non Negroid split occurring about 110,000 years ago and a Caucasoid-Mongoloid split occurring about 41,000 years ago. Regardless of the accuracy of the true estimates, the temporal ordering fits exactly the r/K framework. As populations moved north, the greater were the hardships and the more stringent were the selection pressures for intelligence, forward planning, and sexual and temperamental restraint. This theory implies that North European and North Oriental populations will also be more K than their southern counterparts, and that, within each race, higher socioeconomic groups will be more K than lower socioeconomic groups.

A very large volume of data has been ordered by the theory. That across populations brain size negatively correlates with gamete production and both of these covary with a suite of other life-history variables in predictable ways (including speed of physical maturation, sexual and temperamental restraint, law abidingness, and longevity) attests to the power of the r/K formulation. The r/K theory is the first truly scientific explanation of racial-group differences. I invite interested readers to examine the full account provided in my articles in *Journal of Research in Personality* and *Personality and Individual Differences*. Readers may write to me directly for copies.

J. Philippe Rushton
Department of Psychology
University of Western Ontario
London, Ontario N6A 5C2,
Canada

**To the Editor:**

Since Beverly Halstead's rejoinder (MRJ 24) concerns my letter to MRJ, I would appreciate it if you would use the following:

The issue is whether Bushmen and Australoids are both desert-adapted and intellectually unimpressive. Granted that the Bushmen were pushed from the south African savannas into the Kalahari in recent centuries by more warlike peoples, the fact that they are desert-adapted is proved by their survival. That they are mentally ill-favored is indicated by their small brain size (Baker, Race, 1972) and by their dearth of civilizational achievements. The same, I believe, is true of the Australoids, about whom I know less.

Congratulations on your decision to publish both the Richard Lynn article and the commentary. I hope you have not generated a storm of adverse criticism. Sometimes one must swim against the establishment currents to achieve anything. Your decision was courageous and moral courage seems more in short supply than it once was.

Nathaniel Weyl
855 Oleander Street
Boca Raton, FL 33486

**To the Editor:**

Before I get serious, I'd like to note in regard to Jensen's observations about myopia correlating with IQ (MRJ, 24, p. 24) that bright kids in cartoons are often depicted wearing thick glasses, e.g., Oliver in Breathed's strip, "Bloom County." You can doubtless think of other examples of pro-

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fessors and rabbis portrayed as myopic. Artists often see things before statisticians do.

Recently, in a discussion of Richard Lynn's theories, one man remarked laughingly, "If you'd had to learn to read Japanese, you'd have a low verbal ability, too!" Later, his remark set me thinking about John Ceccherelli's statement (MRJ, 24, p. 4) that ". . . the language one thinks in actually structures his thinking process and itself limits possible solutions and options." That, of course, is a restatement of the Whorf-Sapir hypothesis about the influence of language on thinking. In the context of Lynn's evolutionary theory, however, it occurred to me that both the jocular comment and Ceccherelli's observation may be viewed in a different light. This led to a partly baked idea which could be relevant.

Let me first make an admittedly superficial comparison of the Japanese language with English, keeping in mind that I am using Japanese primarily as an example of an Asian language. (Yes, I know. Neither is prototypical of its language family, but bear with me for a moment.)

As compared to English, Japanese presents a far more difficult learning problem for several reasons, the most obvious of which is the writing system. (A discussion of the syntax would be more enlightening, but I have neither the expertise nor the space for that.) Japanese orthography includes both Japanese symbols and Chinese-derived symbols: Kana and Katakana. In addition, Japanese can be written in a kind of phonetic alphabet (Hirigama) and also in Roman letters (Ramaji). To be fully literate in Japanese is to be able to read ALL of these! Korean somewhat parallels this situation, using Hangul (a phonetic system) plus Chinese-derivative Kanji. Written Chinese, as most of as know, uses a system of ideographs, each (or combinations of them) representing individual words, but often with less than optimum precision.

Now let's hypothesize something we might call "linguistic efficiency." I will define this idea (again only partly baked) as related to the costs in time, anguish and economic (i.e., survival) value of learning the language and of communicating in it with a minimum of ambiguity. It may be irrelevant here that more books are published in English each year than in any other language, perhaps than in all other languages. Examined from the point of view of "linguistic efficiency," Japanese, Korean and Chinese are perhaps significantly less efficient than English. That may be one of the reasons (there are others, of course!) that English is easier for the Japanese to learn than the other way around. If so, why?

Is it possible that English has evolved into a more efficient language than Japanese because of the higher verbal abilities of Caucasians? Or to put it the other way around, has the evolution of Japanese language been inhibited by the lesser verbal ability of those Lynn refers to as "Mongoloids"?

Evolution of a language to greater efficiency might lie in gradual syntactic simplification and growth of vocabulary. The latter generally permits (or demonstrates?) finer distinctions among concepts and reduction of ambiguity.

Let us turn our attention to Thailand. The Thai, Lao and Khmer are Mongoloids who moved south out of China to their present location perhaps no earlier than the 13th century. The Thai language is quite different from Chinese and Japanese and so is their culture. Though I must rely on

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personal and anecdotal evidence on this, even their language-related humor (e.g., puns) seems to be closer to the Caucasian than that of the Japanese and Koreans. The Thai orthography (Lao and Khmer are similar) is phonetic rather than ideographic and, though more intricate than that of the European languages, seems to me relatively more efficient than the orthographies of Japanese or Korean, and certainly more efficient than Chinese.

One might therefore hypothesize that the evolution of the Thai language toward greater efficiency than the Japanese resulted from a higher verbal ability among the Thais. If Lynn's hypothesis is to hold in this context, the Thais would score lower than the Japanese on the visuospatial factor.

Now let's turn to Halstead's concern (MRJ, 24, p. 17) with whether "many of the differences enumerated by Lynn may not after all have been engendered by centuries of surviving in a conformist, manipulative society." Since the Thai culture is characterized by quite different cultural norms and child-rearing practices, comparative data on the Thais might elucidate his question.

Wouldn't it be intriguing to have some data on these conjectures?

Francis Cartier
1029 Forest Avenue
Pacific Grove, CA 93950-4814

**Correction**

In the last issue of the *Mensa Research Journal*, a letter from Glen Chambers, 410 Riverhills Drive, Temple Terrace, FL 33868 included an incorrect number. Mr. Chambers asks that his letter now read, "In East Asia the transition from Homo erectus to Homo sapiens only began about 250,000 years ago."

***By Invitation Only***

# The Gifted Disabled

*Kathleen Spaltro, Ph.D.*
Publications Chairman, Mensa Education and Research Foundation

Supporting Emotional Needs of Gifted (SENG), a program of the Wright State University School of Professional Psychology in Dayton, Ohio, has been sponsoring the efforts of clinical psychologist Robert N. Basil, Psy.D., to improve the lot of the hearing-impaired gifted. Dr. Basil hopes to counsel more effectively the parents of deafened gifted children making perplexing decisions about education, to offer psychological support, and to stimulate better public understanding. Engaged in surveying the professional communities involved with the hearing impaired, he wants to generate the now-absent data that will guide his future efforts. Dr. Basil's highlighting of the hearing-impaired gifted as a neglected group allows me to share a personal perspective: that their existence and plight teach us a great deal—about themselves, yes, but also about the handicapped of normal intelligence and about the gifted with normal physical functioning.

When I say that the situation of the handicapped gifted, Janus-like, reveals much about being gifted and much about being handicapped, I write out of 33 years' combination of severe hearing loss and high intelligence. I write out of an unavoidably subjective perspective, yet one that may offer insight to others.

What is the situation of the hearing-impaired gifted? A central misperception helps me define it: people generally do not see successful disabled people as disabled—the disabled being inherently unsuccessful. When comedians and columnists mocked Mrs. Reagan for whispering in President Reagan's ear questions from journalists, they forgot that the President suffers from a serious hearing loss. They forgot because they (and the rest of America) do not view Reagan as a disabled man, though he has a disability. Minimizing Franklin Delano Roosevelt's polio, the press reduced their own and the public's perception of FDR as a handicapped man. They knew he could not walk, but his handicap seemed almost irrelevant. Had they violated good taste by focusing on it, they would have revealed the average person's view of disability as evidence of weakness, as something to hide, something not to talk about.

Successful men, FDR and Reagan could not be handicapped as well. Their success erased their handicap, instead of highlighting their victory over it. Because people do not generally view themselves as successful disabled people, they fail as models for other handicapped people struggling to succeed. They fail because the public, being unable to hold in a single thought the seemingly contradictory notions of handicap and success, tends to treat the handicapped as still deficient in spite of achievement, to treat the disabled as unable.

How many people think of Thomas Edison as a deaf inventor? of Senator Robert Dole as a crippled statesman? or Francis Parkman as a near-blind historian?

If you say, "But these people triumphed over their handicaps. That's why we don't think of them as disabled," you have proved my point: disability connotes inability, not success. The successful disabled person leaves behind the disability, but only in the public mind, not in fact.

So far from being irrelevant, FDR's polio became an integral part of him and his success. Success occurs, not only in spite of, but also because of disability. "The world breaks everyone," Hemingway wrote 60 years ago, "and afterward many are strong at the broken places." The handicapped can be exactly that—strong at the broken places—but the places remain broken, and the person remains handicapped. So far from being irrelevant, the handicap helps create the person and the person's success.

The success of the disabled gifted does not change public perception of the disabled as unable. But what do the handicapped gifted have to show us about the gifted with normal physical functioning?

Isolated by their handicaps, they endure further isolation because of their giftedness. Unusual intelligence, like deviant physical functioning, marks them as abnormal. The gifted, like the handicapped, can suffer greatly from a sense of deformity, can seek escape from a too painful awareness of being different. Acceptance of one's giftedness, as of one's disability, translates into a coming to grips with the reality of who one is. To deny giftedness, or to pretend freedom from disability, amounts to self-betrayal. As long as I, a severely deaf woman, pretended to be a hearing person, I suffered from an intermittent but painful sense of fraudulence. Liberation came when I acknowledged, primarily to myself, the fact of my identity as a handicapped person; but others, not understanding, resisted that admission, misreading it as defeatist. So far from being defeatist, it was a cry of victory of social forces that had shamed me from ever admitting the dreaded fact before. A lie is not a basis on which to build a life.

# Colloquium IV Opening Remarks

*Gabe Werba*
Past President, American Mensa

On behalf of American Mensa, on behalf of the Mensa Education and Research Foundation, on behalf of the three Mensa groups that joined together to make this event reality—Lone Star Mensa, San Antonio Mensa, and Gulf Coast Mensa—and on my own behalf, let me welcome you to Mensa's Colloquium IV, a colloquium on "Science and Society: Our Critical Challenges."

If you get excited when minds meet minds, if you get excited stretching your own mind, if you get excited reaching out for new insights, exploring concepts, investigating ideas, if you get excited in stimulating, thought-provoking conversations, then this Colloquium is for you.

Join the company of the many of us here who have come to Colloquium IV to make it all happen, to create that excitement, to share in it.

This is a joint effort. It is a participatory event. If you are here only to listen to speakers, then you will be missing out on what it is all about.

A colloquium is a dialogue. Once the experts have sketched out the issues for us, once we go into the breakout sessions, then we—all of us—become the Colloquium.

We examine the issues, we analyze the problems, we propose answers, we look for alternatives, we consider their implications, we try to come up with recommendations.

But the issues we will be looking into, "Science and Society—Our Critical Challenges," are complex issues. Beyond the technological factors, the political aspects and the financial decisions that must be made, these challenges pose us with moral and ethical dilemmas.

There are no ready answers. If there were, we would have them. There are no clear-cut solutions. If there were, we would see them. There are no simple truths. If there were, we would live by them.

But there is one thing, at least, that we can do. We can take that most valuable of all resources—our mind, our human intelligence—and try to exercise it, try to stretch it, try to push it. We can try to be open to the ideas of others, try to absorb what others will be offering us.

It would be exciting, indeed, if together we would find solutions. It would be exciting, yes—but probably unrealistic. In fact, we are much more likely to find many approaches, to find many solutions. But there is excitement, too, in the seeking of truth, in the search for solutions. Perhaps, out of this weekend, will emerge some thoughts, some ideas on which others may build. Then it will have been worthwhile.

Perhaps you will be inspired to go back and start your own, personal colloquiums. After all, why should such dialogues take place only every two years or so? Why do we need special happenings like this one to start thinking about the issues that face our world? We think nothing of running, of jogging, of exercising our bodies daily. Is it heresy to suggest that we should also exercise our mind? Is it heresy to suggest that intelligence not exercised on behalf of humanity can constitute a moral failure?

Let me suggest that this—this Colloquium—is what Mensa is really all about. It is about exploring concepts, reaching for new insights, seeking for answers in a world filled with questions. It is about participating with others in that search and what happens when minds get together. It is about the potential of intelligence—of intelligence conscious of ethical and moral implications—of that intelligence helping us find a way.

This weekend, let us all celebrate intelligence . . . by applying it.

**Mensa Colloquium IV recorders and facilitators gather in Austin. The Texas State Capitol is in the background.**

# Keynote Address

*Phil Lane*
Four Worlds Development Project
University of Lethbridge, Alberta, Canada

It is imperative that we begin to recognize and realize that until we have received and investigated all the gifts that the human family have to contribute, step out of our limited vision—nationalistic, religious perspective, perspective that divides us according to race—we will not be able to solve the issues that face us. This journey is not a journey of great distance. The longest road you're ever going to have to walk in this life is from here to there—from the head to the heart.

My uncle once said to me, "Look at those trees standing there. What do they say to you?" And I looked at those trees and had no idea what in the world he was talking about. I was completely blind. He said, "Look at the alder trees standing there." He said, "The alder tree doesn't tell the pine tree to move over. Or the pine tree doesn't tell the fir tree to move over." He said, "Each one standing together, with their mouths pressed toward the same mother earth, refreshed by the same breeze, warmed by the same sun, with their arms upraised in thanksgiving, protecting one another." He said, "This is the way that human beings are going to have to live with one another if we're going to have peace in this land and going to be able to survive."

There was a little stream going by. Again, he said, "What do you see in that stream?" And I looked again and had absolutely no idea what he was talking about. I thought there was a fish there or something. He said, "Pick up that water there and feel it. Feel how gently and how lovingly it touches your hands. You know that water goes through deserts, through mountains, everywhere. But it never turns its back on anybody or anything. You can put that water in any size container, but that water is always itself. It never talks out of both sides of its mouth. You know that water, even though it gives life to every living thing, there's nothing that can exist without water, has great humility. It always seeks the very lowest spot. You know that water has so much patience, so much courage and so much faith, that even if a mountain stands in its path, it keeps moving, it keeps moving, it keeps moving, it keeps moving, and finally that mountain is washed away and is no more."

He said, "These are the qualities that we must develop as human beings, if we're going to have peace on this mother earth."

The tribal elders said, "This universe we live in is organized according to certain natural laws—physical laws and spiritual laws—both of which are related and connected. Of course, the physical laws are easy for us to see. If I go to Bombay, India, and jump off a ten-story building, I'll probably break my legs. If I jump off a ten-story building here in Austin, I'll probably break my legs. If I drink a glass of arsenic, I'll probably die. And so will anybody else here in this room. But even more important, or just as important, are the spiritual laws. And they are just as real as the physical laws."

They said, "One of those laws that has to be practiced if we are to have any kind of peace on this mother earth, regardless of all the political actions, regardless of all the great meetings, is the Law of Forgiveness." And they said, "It's the law."

We had a ten-year longitudinal study and we had one group of people who had learned to accept themselves as human beings, that is, we make mistakes, and we learn through those mistakes, and other people make mistakes. That's part of our nature as human beings. The other group, who chastised themselves every time they made a mistake, or anybody else around them, who continually looked at themselves as being right and other people being wrong, over ten years it's very easy to see the outcome of who would live healthier lives, based on various indicators of wellness: of course, those people who had learned to accept themselves as human beings and accept others.

Another law, they said, was the Law of Respect. What we give respect to, we give power to. If we give respect to the negativity, then that's what'll come in our lives. If we follow the teaching of a person who has ten bad qualities and one good one—look at the good. Focus on, according to these old people, what's real.

They said that, for human beings to develop, they need a vision. No vision, no development. But the vision that people needed—and children especially need—is a vision of wholeness and wellness by the human beings around them.

According to Joseph Chilton Pierce, who is becoming more and more recognized as one of the leading thinkers, internationally, in the areas of human development, based on his review of all the literature that's now coming forward about human development, probably about 90 percent of what children learn is not learned at a conscious level but learned by coming in contact with the human beings around them and their states of consciousness or awareness—on many different levels.

Therefore, the elders said, if you want to change anything in this world, you have to change yourself first. And really, that's the only thing you can change. Until we become role models of what it is to be a healthy human being, physically, spiritually, emotionally, mentally, volitionnally, we will not have impact on making the changes we want to make.

This is key, according to our elders. They said the future security and survival of the human family inescapably has to deal with the moral and spiritual dimensions of human development. It's inescapable. There is no way we can develop any kind of system, politically, socially, educationally, if we're morally bankrupt. Unless we foster the qualities of truthfulness, kindness, compassion, humility especially. As human beings, we are all given various gifts. And on one hand, they are great gifts. They enable us to have an ability to so something that other people don't have. But on the other hand, they can lead to great egotism, in which we immediately, rather than listening with open hearts to one another, have a position that I'm right and you're wrong.

I can say as a recovering alcoholic and drug addict, the one thing I'm really pleased about that experience is that it taught me that sometimes you can think you're dead right, and you're dead wrong! And sometimes you can think you're dead wrong! And you're dead right! And the other

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thing is, after you've been down in the gutter, drinking out of wine bottles, it's a great relief to know after that path that you don't have to carry around an air of judgment to other human beings. We're all involved in a process of growth and development, part of which we make mistakes and part of which we have successes. At the same time, I don't want to suggest that the path before us is easy. For I really believe we have to walk the path of the heart with practical feet.

I remember, back in 1969, after I had gone through this tremendous difficulty with alcohol and with drugs, I began turning inward, and realized that I had enough pollution in here (heart) to deal with; because really, everything that is manifested in the physical world around us is a direct reflection from here. The skid rows and the acid rain and all the pollution we're facing are a direct reflection of the pollution and acid rain and so forth we have in the heart that needs to be cleared away. Until we begin looking in here and investigating here, and changing our own consciousness, we're not going to be able to change the manifestation of that human consciousness which is outside ourselves.

Some of those principles that the elders gave us, as well as from my own experiences, I believe must be pursued if we are to emerge as promised in all the native prophesies into this new age of development.

First and foremost, I believe, is the independent investigation of truth. But in order for us to truly independently investigate truth, we have to do so with a pure heart, empty of prejudice, dogma, and superstition.

Secondly, I think we have to recognize that spiritual development, or religion, or whatever you want, the development of positive life-enhancing, life-preserving values, must go hand in hand with science. Religion without science becomes superstition. At the same time, science without moral and spiritual values becomes materialism.

And it's the materialism, as I see it, that leads us to separating human beings according to skin color. How can anyone, and I'm sure there's nobody here that has that kind of thing inside, how can anyone with any kind of intelligence separate human beings according to skin color? Or, not recognize the equality of men and women? Our elders tell us the eagle has two wings—one is men and one is women. And until both the wings of the eagle have power and respect and honor, the eagle of humanity will never fly its highest.

I think, as men, who have such a tremendous influence in the world, we especially have to look inside here (heart). We die ten years younger than women. The hundreds of women I've counseled all seem to say the same thing: we don't share our feelings. We live up here (head); we don't live down here (heart).

It's vital, if we are to develop as human beings at this stage of development, that the feminine aspects or the insights, and the physical and masculine elements of who we are as human beings needs to be balanced and integrated.

The Hopis have a very, very insightful prophecy about the day we live in. And this is what they said, long before other members of the human family came here: "Beware. Because there will come a time when other members of the human family are going to come here. And many of them will have forgotten their own way of truth and understanding. And beware," they said, "because when that day comes, people will build trails in the sky and travel across those trails in birds." And they said, "Beware, because when that day comes people will build cobwebs across this land and talk across those cobwebs. And beware, because when that day comes, people will build trails across this land, and travel across those trails in bugs. And beware, because when that day comes, people will reach into the earth and find the power. If it's not used in a good way, it will be like dropping a gourd of ashes upon the earth. And whatever it touches, nothing will grow for many seasons." And they said, "When that day comes, the earth will be shaken three times before entering the fourth world."

And it's interesting when you see the symbols they've used to indicate the first shaking of the world, which exactly prophesied World War I. And they said, "The second time the earth shakes, two of the powers will shake the earth. One will have the sign of the rising sun, coming from the west, and the other will have the sign opposite that of life." And among the southwest, northwest as well as Canadian tribes, we have a sign for life. It's the exact opposite of the sign used by Nazi Germany. They call it the sign of the whirling logs. At the end of World War II, the elders said, "Now, after the second shaking has occurred, look to the eastern part of this land and you'll see a great house of mica that will be built. Where people from all over mother earth will come to talk about peace." And of course, the United Nations. They also talked about the space station and the tremendous changes that would take place there. And they said that, through this tremendous process, that we would enter into the fourth world.

This fourth world is actually the emergence of the human family to maturity or adulthood, the first stages being infancy and childhood; the third world that they say we're in is the stage of adolescence as a human family. And that collectively, we're moving into the state of maturity.

And it's important, I think, to recognize this kind of unfolding; that on one hand, we say that we all want peace, and on the other hand we use the argument, but it's impossible because look at the history of human beings, we've always fought each other, that's our nature, there is no way that we can achieve peace on this planet.

But we must understand that within infancy are potentialities that are not manifest until childhood. And if we try to understand childhood only by the potentialities actualized in infancy, we'd never understand the fullness of childhood. And at the same time there are potentialities that we have as human beings that are emerging at this time in history that have never, ever been seen before, except for those unique human beings who have been a manifestation or visualization of our true capacities as human beings.

I believe, for instance, that each one of you here who have achieved such a distinction or gift in the intellectual area, represents potentiality that will more and more be seen by greater and greater numbers of human beings as we go forward into the future. Just as we can see in other areas of development, we're just beginning to enter into a tremendous, powerful explosion of human potentiality. Everything is changing. That is a reality. Wave energy, particle energy, but everything is changing. And change presupposes process. That is, everything in this universe is in process. Infancy, childhood, adulthood, eldership . . . spring, summer, fall, winter . . . everything is in process. In fact, native languages are distinguished by the fact that they are verb dominated. That is, they see the world as a motion picture. English, of course, is a noun dominated language. We need to integrate both the motion picture view and the snapshot view of reality.

So if everything is in change, then every new situation, every moment of our life is a little bit different than the moment before. And if our minds are encumbered by prejudices, by hatreds, by anything that keeps us from having an open heart, a mind that can penetrate each new situation in a new way, we will not be able to solve the issues that are continually changing, and developing around us.

I hope that I've pushed some buttons here. And as I look out, I can see I have. I had to come here and be honest with what I feel, as best I could. And I do really believe it's the engagement of the heart in a passionate, sincere dialogue that will lead to some conclusions that we can all join with in solving these problems that face us.

But in doing so, I hope we can also have a good time this weekend. Because insights come, I believe, many times when the intellect is not continually hammering at the problem. The discovery of the benzene ring, after so many years, occurred while Kikuly sat in his study, and he had a little dream of a snake chasing its tail. It didn't come while he was engaged in the problem of trying to understand this great theory in chemistry. The discovery of the sewing machine after many years of trying came when the inventor went to sleep and had a dream of a bunch of knights in shining armor coming along with lances going through their stirrups, and all of a sudden he looked at the bottom of the lances and there was a hole in the bottom of the lance. And that was his main problem: all those years he kept trying to put the hole in the needle at the top, which had been the usual way of doing it, rather than at the tip.

So it's my deep hope that we can have some laughter during this process. At the same time, it's my deep, deep prayer and hope that, as Mensa has distinguished itself as a leader in the intellectual development of human beings, that it can also distinguish itself as a leader in the development of the heart, of the qualities of compassion, patience, forgiveness, humility, understanding, respect, honesty, for without those life-preserving, life-enhancing values, no amount of dialogue, no amount of intellect is going to develop a world in which we can truly reach our potential as human beings.

Thank you very, very much for your kind attention. When I was invited here, I was assured I would want to speak from my heart, because I believe that this touching of the heart stimulates true dialogue. I look forward to the clash of differing opinions igniting the fire of truth.

# Allocation of Resources

*Kevin O'Rourke, OP*
Director, Center for Health Care Ethics
St. Louis University School of Medicine

You have all heard the statement, "War is too important to be left in the hands of generals." My approach to planning for health care is somewhat similar: "Health care is too important to be left in the hands of physicians and bureaucrats." Health and health care are among the more important goods of human life. In this presentation I hope to discuss the present state of affairs in regard to the health system in the United States and what we might do to improve it.

What is health? In this discussion I shall use the definition of Henrik Blum: "Health care is anything which enables people to strive for health." Notice that many personal decisions are involved in pursuing health; because of the nature of health, we need the help of others to strive for health; thus, the need for health care. In our discussion I shall focus on three issues: the funding for health care, the system it has produced, and the ways in which we might improve the present system.

## The Present System

In the year 1987, $500 billion was expended in the United States on health care. Of this sum, hospitals received about 44 percent, physicians received about 23 percent, nursing homes about 10 percent, noncommercial research about 2 percent, and expenses for such things as pharmaceuticals, home health care and dental care amounted to about 20 percent. We derive a more accurate idea of how health care expenses affect our total society if we realize that in 1987 health care expenses amounted to 11.1 percent of the gross national product (GNP) and the federal government estimates that in 2000 AD, 15 percent of the GNP will be devoted to health care. Considering percentages of the GNP indicates that the more we devote to health care, the less we will have for other needs such as education, social programs for the elderly and young, police and fire protection, programs for clean air and clean water.

When computing the expenditures for the health care system it is usually pointed out that 40 percent of costs are paid by the federal government, 30 percent are paid by private insurance companies, and 30 percent by private citizens. However, I think it is important to realize that both the federal government and private insurance receive their funds from private citizens. Realize this, that the health care bill is being paid by you, and that about 12 percent of all you earn, own, and produce is going for health care.

## The Results

What are you getting for your money? One way to answer that question would be to describe the wonderful advances in medicine: to say that by the year 2000 we may have an average life expectancy of 85 years and that we shall know the place and purpose of every single gene in the human genome. However, I think we need to look at our health care system more thoroughly because while this system has some very good characteristics, I believe that there are other characteristics which are problematical. These less attractive characteristics I believe do not reflect the type of society which thinking people desire. In order to be brief, I shall survey the characteristics of our health care system—more time could be devoted to each statement, but realize I am presenting a general picture, not a microscopic analysis.

Our health care system:

a. emphasizes technology as opposed to quality care as the measure of excellence. In the last 10 years, three systems of imaging have been developed: computerized axial tomography (CAT scan), magnetic resonance imaging (MRI) and positron emission tomography (PET). Each machine costs millions of dollars but there is no indication that the new technology has improved medical diagnosis. There is no doubt that imaging has improved, but there is no evidence that improved imaging has improved quality care. Medical diagnosis is made from clinical signs. Technology simply confirms a good diagnosis. What is the contribution to the health of the general public derived from technological advances?

b. emphasizes physiological function at the expense of social or creative function. Remember the definition of health care offered from Blum: "optimal human functioning." In order to have human functioning, we must integrate our powers, integrate the goals we seek so that we have an integrated and balanced set of goals. The emphasis medicine places upon physiological functioning is most evident in care of the dying. Once life support equipment has been applied to seriously ill people, few physicians will readily withdraw such equipment; too difficult to admit defeat. A visitor from a distant planet, viewing our state and private medical institutions, would draw the conclusion that prolonging physiological function is the goal of our health care system. Indeed, the courts are beginning to accept this fallacious evaluation of human life: that mere physiological function with no hope of restored cognitive-affective function is a good to be pursued in human affairs. The tradition in medicine has always been to withdraw care after it proves ineffective or when it causes a severe burden to the patient which is more serious than the benefit received from the treatment.

c. emphasizes acute care facilities and physicians as opposed to preventive care centers and health educators. In stating this proposition, I have no intention to belittle the need for acute care; no matter how well we provide preventive care, we will always need acute care facilities. But my contention is that we could serve the needs of more people with neighborhood educational centers as the first line of medical care. In these centers, there would be help available in working with the more common maladies in our society, such as obesity and stress, and there would be referral procedures to physicians if more serious patient needs were discerned. To put it one way, we attack mosquitoes with sledge hammers instead of fly swatters; moreover, we medicate for some illnesses which would be better handled by a change of behavior.

d. emphasizes hi-tech care for those who can pay as opposed to basic care for all. "Those who can pay" are not necessarily the wealthy; some people qualify for care in the system through federal programs such as Medicare and Medicaid. But there are 35 million people in our country who have no private or public health insurance. Thus over 10 percent of our people have no access to adequate health care, and many of those without insurance are children; this is creating a vicious circle of poor health, poverty, poor health. The United States ranks on the lower quadrant of 20 industrial nations insofar as infant death statistics are concerned.

## What To Do

While the foregoing is not a complete analysis of the strengths and weaknesses of our health care systems, it does indicate some of the problems that we as a nation must face in the immediate future. How can we as individuals respond to these problems? There are definite actions we can perform to help make a difference.

a. Private decisions in regard to health care. In so far as our own health care is concerned, we must realize that we are responsible for our health. This will bring a new appreciation of "preventive medicine" into our lives and when we are in need of the help and guidance of health care professionals, lead us to be less passive than we usually are. A recent book by a physician, *Taking Charge of Your Medical Fate* (Horowitz, Random House) challenges us to ask the difficult questions when we are in need of professional assistance. Before agreeing to surgery, for example, always ask for a second opinion, request a description of potential outcomes and ask the surgeon in question the track record of various hospitals insofar as the surgery is concerned. Horowitz suggests that if you don't receive a satisfactory response from surgeon or hospital, then find another surgeon or hospital. The goal of assuming an active role in your own health care is not to establish an adversarial or confrontational relationship with all physicians; rather, it is to help you make more accurate and beneficial decisions about your own health care. You will never be as competent to discern your own physiological or psychological condition as would a physician, but because there is more involved in health than physiological and psychological analysis, and because health care professionals need encouragement to be patient and exacting in their work, you will benefit by being more active in determining your own health care.

b. Public decisions in regard to health care. Changing the public policy in regard to health care is more difficult, but nonetheless possible. The first step, it seems, is to widen the decision-making base for public policy. For years, only physicians, through the AMA, the National Institutes of Health (NIH) and the National Institute of Medicine, made most decisions for health care policy. At present, these groups are still influential, but they are being replaced by the staff of the various congressional committees that are concerned with health affairs. The federal government funds almost half of our health care expenditures, so the various committees which recommend allocation of funds have become extremely powerful in the health care field. This transfer of power is not disturbing in itself, but two things should be observed: the decision-making is still being done by an oligarchy; only a few have anything to say. Second, the only "plan" of the congressional bureaucrats is to cut costs. There is never any mention of changing the system or investigating priorities. The best method for broadening the decision-making base is to have any professional group to which you belong lobby for more influence in health care decision-making. Alone, a broader base of decision-making will not solve our problems; we also need a new set of priorities. We need an explicit expression of the goals we are trying to obtain and an admission that there are limited resources to attain these goals. Daniel Callahan in *Setting Limits* (Simon and Schuster) has brought to public consciousness the need to evaluate the Medicare program. While many dispute his specific conclusion, his general thesis, that we cannot help everyone live as long as possible through public funds, has been overlooked. We do not at present have anything resembling a plan for our public health care expenditures. I suggest a model for broadening the base of decision-making and for setting priorities in accord with our public resources is the President's Commission on Ethics in Medicine and Research. This commission, composed of people from many different professions, studied the prominent ethical issues in medicine and research in the early 1980s. Thus, they published studies on informed consent, criteria for brain death, genetics, and other issues. The work of the commission was not perfect but it did establish a set of ethical norms and conclusions which state a consensus for our pluralistic society. Thus, we have a model to follow if we ever get serious about planning allocation of public funds for health care.

## Conclusion

While this panorama of health care concerns and solutions is not complete, it calls our attention to the two questions which underlie all consideration about health care in our country. Those questions are: is health care a public responsibility or a business? is health care a commodity or a service?

# Critical Challenges in the Ecological Sciences: A Chess Game in Three Dimensions

*Mary E. Carter*
Associate Administrator, Agricultural Research Service,
U.S. Department of Agriculture

The world is going to hell in a handbasket. Or, on the other hand, maybe this is the best of all possible worlds. Whatever your view of today's world and tomorrow's environmental prospects, it probably reflects this kind of polarized, emotional response. There doesn't seem to be much middle ground on this question of the global ecology.

I am reminded of a cartoon from the *New Yorker* magazine early last year. In the cartoon, an editor is saying this to a writer: "I wish you would make up your mind, Mr. Dickens. Was it the best of times or was it the worst of times? It could scarcely have been both." These words might also be used to describe today's environmental situation.

Our world is faced with many ecological problems, among them the greenhouse effect, deforestation and desertification, ozone, waste disposal, and overpopulation. The world seems on the verge of bursting. Yet for probably the first time in the world's history, there is enough food produced to feed everybody on the planet, if only we could get it to them. Life expectancies are longer than ever.

Are we postponing disaster? Or are we moving ahead into a better world? How important is the environment to the future of life on the only world we have?

I must confess that this has been a difficult meeting to prepare for. I was trained as a chemist. I have been involved in the administration of science for many years. I am not used to raising questions without also proposing solutions. But that is my charge today—to ask you questions that you can begin to answer in your work group sessions.

Someone wiser than I once said that it's better to debate an issue without deciding it than to decide an issue without debate. I commend Mensa for helping bring public attention to issues that we and succeeding generations must face. Sound choices—both personal and societal—must be based on reasoned consideration of an issue in its entirety. Individuals—and societies—should be receptive to new ideas and sensitive to the implications of choice. So let's look at our choices on the ecology.

## What Is Ecology?

Ecology is the term we use to define the complex interactions among the natural resources of soil, water, and air and the living organisms, including people, that depend on those resources. Ecological processes are extremely complicated. It follows that solutions for ecological problems will be achieved only after careful consideration of the total ecosystem.

There is a basic ecological principle that says, "We can never do merely one thing." Or, in the words of Earl Weaver, who for many years was manager of the Baltimore Orioles baseball team: "Everything changes everything."

As I thought about the topic of ecology, the image that kept recurring was that of a three-dimensional chess game. If that's difficult for you to imagine, it may convey some idea of how intricate ecological processes are. Imagine the forward, diagonal, and sideways moves as two of the dimensions. These moves represent the many factors in our global ecology. The movement of one piece on the board begins a chain reaction of moves in response.

Then imagine a third dimension—a dimension that gives meaning to the other two. This third dimension is the quality of life . . . a sense of health and well-being that will determine the future of civilization. This, ultimately, is why we are concerned about how we affect, and are affected by, our world.

## Global Ecological Problems

Now, having just said that it is by definition impossible to isolate separate ecological issues, I'm going to do just that. Let's review some of the problems using the terms that are now in the public forum.

The greenhouse effect is the result of our dependence on fossil fuels. Burning these fuels in our cars and factories and to generate electricity, for example, produces a gradual buildup of gases such as carbon dioxide and nitrogen oxide and other pollutants in the upper atmosphere. This layer of gases traps heat near the surface of the earth.

The greenhouse effect is expected to raise air temperatures, melt the polar ice caps, raise the levels of the oceans, and alter climate. Scientists disagree on the magnitude of the coming changes and how quickly they will occur, although there is a general consensus that we will experience the greenhouse effect soon, if we aren't already beginning to.

Deforestation and desertification are often, but not always, related. Every day, some 75,000 acres of tropical forest are cut down for wood or conversion to agriculture or development. The immediate result is the extinction of entire species of flora and fauna. A broader consequence may be significant climatic changes around the world.

Deforestation also contributes to desertification, which is the encroachment of deserts into farmland. This is occurring at the rate of 40,000 acres a day, mostly in sub-Saharan Africa. Overgrazing, excessive harvesting of wood for fuel and shelter, and exploitative farming methods contribute to the problem.

Ozone is another problem—actually two problems: too little ozone in the upper atmosphere where it is needed, and too much ozone in the lower atmosphere where it is not.

The ozone layer in the upper atmosphere filters out incoming ultraviolet radiation. The most likely cause of the thinning of the ozone layer is emissions of chlorofluorocarbon (CFC) gases and solvents. CFCs are widely used in industrial countries for refrigeration, air conditioning, manufacturing, cleaning and other purposes. Ultraviolet radiation causes skin cancer, and it has been estimated that each 1 percent loss of ozone could increase skin cancer rates by 3 to 6 percent.

Ironically, the second part of the ozone problem is an excess of the gas in the lower atmosphere caused by the burning of fossil fuels, particularly gasoline. Ozone concentrations cause health problems and reduced crop yields.

Waste disposal is becoming a thorny problem, particularly in industrialized societies. Personal trash—an average of 25 pounds a week in the United States. Industrial wastes—many of which are toxic. Nuclear waste. It is a problem that cuts across every segment of society.

Experts say that we have three basic options for getting rid of these wastes: bury them, burn them, or recycle them. Burying depends on landfills, and landfills require land—a resource that is becoming increasingly scarce and expensive near our population centers. Burning increases the potential for air pollution. And recycling depends on appropriate technology and on markets for the products.

Population growth may be the most significant problem of all. Demographer Carl Haub says that last year's population increase was 90 million people—the largest increase ever in a single year. And although population growth is small in the developed countries, it has recently been higher than expected in the less developed countries where most of the world's population is concentrated.

Where will the growing world population live? How will they eat? What demands will they make on the soil, water and air? How will they cope with the severe social and psychological pressures attendant on rapid population growth?

## Ten Questions

These are some of the problems. What are we going to do about them? What can we do about them? I want to ask ten questions that you may want to consider as you grapple with these issues this afternoon.

1. Are there only two points of view? Can we find a middle ground? The environmentalist Lee M. Talbot takes the view that the solution lies in conservation, which encompasses both preservation and utilization. He argues that conservation is ultimately everybody's responsibility—individually and collectively.
2. What are the limits of personal responsibility? Certainly, individuals can have an impact—especially in the United States, where we consume resources disproportionately to our share of the world's population. We can drive our cars less. We can buy more efficient furnaces for our homes. We can choose to buy goods without excessive packaging. We can recycle used goods. We might call this attitude a conservation ethic. How much progress could a renewed conservation ethic foster?
3. How far should governments go? We can encourage the adoption of policies at every level of government that promote conservation—from restrictions on trash disposal such as separation of glass and paper to mandated increases in fuel efficiency in automobiles. Regulations on toxic waste management are being written almost daily. Regional governmental

efforts are underway for specific purposes, such as the Chesapeake Bay cleanup. Most people, at least in the United States, can agree with this kind of role for government. What else can government do on a local or national level?

Since the environment is an international concern, there is also an obvious need for international accord among governments. For example, an international treaty for protection of the ozone layer was adopted in Montreal almost exactly a year ago. International conferences are being held on hazardous waste disposal, and perhaps an accord will be reached on that issue as well. How are our governments following up on these and other environmental issues? Have we yet recognized that pollution is an international, not just a national, problem? How can we persuade more countries to become parties to such agreements?

On the subject of waste disposal, I almost became involved in what could have been an international incident earlier this week. A Soviet nuclear satellite had lost power and appeared to be on a collision course with the earth. We were concerned about its potential effects on food and agriculture. But at the last minute, an automatic correction occurred, sending the nuclear power source into deep space. The satellite itself mostly burned up during re-entry. Had this not occurred, over 100 pounds of radioactive material would have fallen to earth somewhere, perhaps even in a densely populated area. How should nations deal with military matters such as this or development of chemical weapons?

4. How much can we depend on science and technology for solutions? Many of today's ecological problems developed on a parallel course with development of new technology in our industrial age. But we should never think that air pollution, for example, was not a local problem before the advent of modern factories. Or that water was never polluted by salt or sulphur or other natural pollutants. We have inherited the world we live in, and we will not be able to turn back the clock—even if we believed that was desirable.

Here is a contemporary dilemma. Most of the electric power generated in the United States and around the world depends on the burning of fossil fuels. Emissions from this burning contribute to the greenhouse effect and the ozone problem. Aesthetically, they are a nuisance. There is a technological alternative to burning fossil fuels—an alternative currently in use. Maybe it's time we gave nuclear power another look. This is a question for society to decide. Was Chernobyl a fluke? Could it have been prevented? Is the risk of another Chernobyl an acceptable trade-off for reductions in air pollution and other environmental problems?

On a less dramatic note, let me give you an example of technological progress from my own agency, the Agricultural Research Service. This is the development of biodegradable plastic films made from cornstarch. These films could replace non-biodegradable plastic mulches and trash bags made from petroleum—a nonrenewable source. Would you be willing to pay a few cents extra for a trash bag that won't stay in the soil for a hundred years?

Here is another example for you to think about in your work groups. Should we develop a model of the global environment to predict the ripple effects of changes in ecological components—such as an increase in atmospheric carbon dioxide levels? And should we seek agreements with other nations to abide by the answer "trends" of such a model? In what international arena should we be discussing this? Whose responsibility is it to educate the citizenry?

The June 1987 *Scientific American* reported on just such a project: a planned multi-million-dollar, multi-decade International Geosphere-Biosphere Programme. The project would include scientists from many disciplines, and it could potentially help us direct our research and development where it would be most effective.

5. How much can we trust political solutions? It has been suggested at this colloquium that a change in attitude—for both individuals and government—is needed. I can't argue with that. For many years, for example, the conservation of soil and water has been considered a matter of stewardship and primarily the responsibility of the farmer. Most farmers in the United States practice good stewardship, and an extension of this concept to society as a whole would be welcome indeed.

Because ecological issues are so emotional, the solutions are going to be political. I understand this, but as a scientist I am leery of political solutions that fail to take into account the opportunities that science and technology give us.

I fear a backlash against science. I fear the growth of an attitude that blames science and technology for our problems and promotes a return to "human" values, excluding science and technology, as the solution. Both need to be part of the solution. It would be foolish and probably disastrous to exclude science in attempting to solve the many problems we face today. We cannot afford to overlook any tool at our disposal.

6. Are we shutting out the less developed countries? Conservation may make perfect sense to people in industrialized nations such as the United States. Most of us have the luxury of taking the long view. In some of the less developed countries, however, surviving today is the overriding objective. Attempts at conservation may be completely at odds with local traditions and may furthermore be viewed as another attempt at exploitation.

In this regard, there are those who believe in organic production of food at any cost because they fear the consequences of food production using synthetic pesticides. Almost everyone agrees that—for now, at least—food production without agricultural chemicals would reduce the quantity and quality of food. Is this a luxury we can afford when the global population is growing at such a rapid rate? Is this a tradeoff we want to make? Can we make the transition gradually, as alternatives become available? Already, we are noting a buildup of resistance in a few insects against "natural" toxins. Where do we look for our third generation of protectants? Is there a role here for our genetic engineering methodologies?

7. Are solutions permanent? No matter what we do, we are likely to see unintended and unforeseen problems. For example, a hundred years ago, one of the major ecological problems in New York was horse manure. Transportation in the city was provided by four-legged horsepower, and the emissions of the day were piling up faster than Nature or the city's sanitation department could take care of them. Lack of adequate disposal was creating very serious aesthetic and health problems. The advent of the horseless carriage—a "nonpolluting" form of transportation—solved the problem. Can we afford to wait for the perfect solution?

8. Can we trust our senses? I must also caution you that cause-and-effect relationships are not always as simple as they seem. For example, in northern Europe the population of storks has been declining over the past several decades. There has been an almost exactly parallel decline in the human birth rate over the same period. Does this mean that storks bring babies? Few of us still think so. We all ought to remember that relationships which appear to be self-evident often aren't. And I hope you left sylogistic logic on the shelf a long time ago.

A study of temperature variations at Washington, D.C., and at three rural sites within 200 miles of Washington bears this out. The study shows that the average temperature in Washington is about four degrees warmer than it was in 1900. This has led people to say that the greenhouse effect is already here. But the temperature increases in the three more remote towns were much smaller—less than two degrees over the same period. This suggests that most of the temperature increase in Washington was a localized phenomenon caused mainly by the proliferation of heat-trapping buildings and highways. Another factor could have been the relocation of the official thermometer to the airport.

**9.** What's the price tag? Environmental concerns are high on the nation's agenda right now. I, for one, think that this is as it should be. Life cannot continue without natural resource conservation. But they are not our only concerns. Disease prevention, food distribution, and maintenance of public works are among the many international social concerns. We aren't likely ever to have the resources—and by resources I mean cold, hard cash—to do everything we would like to do, or even everything we need to do. So we have to set priorities. I find this true in the management of the Agricultural Research Service, and humanity is also finding this true in the management of spaceship earth. How much are we willing to pay?

**10.** Is Nature benign? Don't kid yourself. Nature is indifferent. Clear lakes, purple mountains, bucolic meadows, and beautiful waterfalls are Nature. But so are grasshoppers, Hurricane Gilbert, and radon. "Natural" is not always better, at least if we are talking about the survival of the species.

## Our Chances of Success

Environmental issues have gained new adherents—but they bring more pragmatism and more of a scientific approach to the problem than did the environmentalists of the sixties and seventies. For example, the World Bank—often criticized by environmentalists for putting short-term economic considerations first—has emerged as a leader among international development agencies in promoting environmental concerns.

This is the only world we have. It has problems. As my favorite 'possum once said, "We have met the enemy, and he is us." But surely, if we have the capacity to create the problems, we have the capacity to advance solutions. And if we succeed, it will be a far, far better thing than we have ever done before. The greatest failure of all would be not to try.

## Critical Challenges in the Ecological Sciences
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# Changing America: The New Face of Science and Engineering

*Sue Kemnitzer*

Executive Director Task Force on Women, Minorities and the Handicapped in Science and Technology

Our advanced industrial nation—the America we have taken for granted for more than a generation—is changing.

Our society is changing: more people are old; fewer are young; more come from minority groups.

- Between now and the year 2000, the number of young people in our population will decline by about 20 percent while the overall population will increase by 18 percent.
- By 2010, one in every three 18-year-olds will be Black or Hispanic compared to one in five in 1985.
- The ratio of workers to Social Security beneficiaries was 16-to-1 in 1950, is presently 3-to-1, and will drop to 1-to-1 after the year 2000.

Our industry is changing: we are not the world economic leader we were for so long, but a competitor with other industrial nations.

- You know from driving down the major roads of our cities that foreign automobile makers have the lion's share of our market.
- Our market share of phonographs, TVs, video cassettes, and telephones is about zero. And all of these products originated in the United States.

Our education system is changing: Although our colleges and universities are the envy of the world, they are becoming more and more dependent on foreign students and faculty. Our precollege education system has reached a crisis state in which United States students are no longer competitive with those in other industrialized countries.

- In 1986, U.S. universities awarded 3,400 Ph.D.s in engineering. Of these, about 1,600 were to U.S. citizens, 139 to women, 25 to Hispanics, 14 to Blacks, and six to American Indians.
- Compared with students of other countries, U.S. students score at the low end on mathematics achievement tests.
- Among 13 countries which participated in the recent science achievement tests, the United States placed 13th in biology, 11th in chemistry and ninth in physics.
- Only half of our 17-year-olds can correctly answer the question, "What is the area of a rectangle 4 cm by 6 cm?"

Our present scientific and engineering workforce—the foundation for U.S. technological, economic, and military leadership—is eroding due to retirements and declining student interest.

- In the period 1995–2000, a very large proportion of our university faculty will retire. In some cases, campuses face 100 percent turnover.
- Who will replace them? Freshman student interest in science majors has declined by 1/3 over the past two decades. Interest in engineering is down by 1/4 since 1982, and interest in computing careers has fallen by more than 2/3 in four years.

In the year 2000, 85 percent of new entrants to the nation's workforce will be members of minority groups and women. Meanwhile, the number of people with disabilities who can go out into the workplace will rise. These three groups have historically been underrepresented in science and engineering. The nation can meet future potential shortfalls of scientists and engineers only by reaching out and bringing underrepresented groups into science and engineering. America's standing and competitiveness depend on it.

Indeed, unless parents, schools, colleges, professional societies, industry, state legislatures, federal agencies, the President, and Congress act in concert, our national science and engineering workforce will continue to erode and the prospects for maintaining an advanced industrial society will diminish.

**Some Specific Suggested Actions:**

1. Start early. . . . There is an overwhelming body of research which indicates that early influences have a significant effect on a child's readiness for school. Programs, such as Head Start, which emphasize involvement of parents are especially successful. However, at present only 18 percent of the children eligible for Head Start are able to participate in it.
2. Concentrate on math in the early elementary grades. . . . Unfortunately, children get turned off by, or feel left out of, math study by the time they are in fourth grade. Too often this negative trend is reinforced at home. Family math and more positive experiences at school are ways to start reversing these trends.
3. Raise high school graduation requirements. . . . One key to raising achievement is giving our children more content. No wonder we score so low on international comparisons since our children take fewer courses in math and science. Four years of math and three of laboratory science are necessary.
4. Make college affordable. . . . How can you encourage someone to go to college when the loans they will have to assume exceed their family's annual income? Money should not be a deterrent, but an incentive.
5. Make the most of community colleges. . . . Women and minorities tend to start their higher education at community colleges because they are located closer to family responsibilities and are more within their financial means. We must be sure that they can transfer with ease to four-year institutions and are encouraged to complete their baccalaureate and higher degrees.
6. Parent and community support. . . . One cannot overemphasize the role of parents in shaping their children's future. That is the way it

should be! But let's also be sure to support parents as they advise their children. The parents who did not attend college may not know the ins and outs of college admissions, or parents with low-skill jobs may not be able to explain the wide array of opportunities possible for their children in the 21st century. Community groups can be a useful resource in these situations. Nancy Russo's Hispanic Mother-Daughter Project, Carl Holman's National Urban League program called Say Yes to Math and Science and Shirley Malcolm's Linkages program are excellent examples. The entertainment industry and mass media, which are all too powerful influences in shaping society's values, must also participate in reshaping popular attitudes towards science and technology.

## Conclusion

The problem we face in the science and engineering professions stems from powerful underlying forces in American society, including discrimination, poverty and deficits in education. Each sector of the nation must now work towards a set of common goals which ensure that all citizens receive a quality education, have access to economic opportunity and are the informed voters that a free society demands.

# Closing Remarks

*Gabe Werba*
Past President, American Mensa

On Friday evening, I had the pleasure of welcoming you to Colloquium IV. I greeted you with the usual: "Ladies and Gentlemen."

Well, it is now Sunday. Colloquium IV is coming to a close, and I will start out by saying, "Dear Friends . . ." because "dear friends" is the way I think of you now. Many of us—maybe most of us—did not know each other when this Colloquium got under way. But we met, we engaged in good talk, we traded ideas, and we made friends, good friends.

One frustrating aspect of making public remarks is all the things you wish you had said but did not . . . or did not think of. And that is what happened Friday night.

Fortunately, I have been given a second chance. Do not worry. I am not about to repeat all my remarks.

But I would like to emphasize some of the thoughts I expressed Friday:

- The Colloquium should not be a once-every-two-year event.
- There should be a national Colloquium every year.
- There should be regional Colloquiums.
- There should be local Colloquiums.
- But, more important, we—each of us—should have personal colloquiums. By that, I mean we should challenge our own ideas, our own concepts. We should not accept the obvious as dogma. We should ask WHY. We should ask HOW ELSE. We should ask WHY NOT.
- We talk about gifted children. But that is us. Grown up gifted children.
- If we have been gifted with intelligence, it is a failure on our part to not use it.
- If we use that intelligence, but just for our own benefit; if we do not use it for the benefit of others, for the benefit of humanity, it is a moral failure on our part. We cannot worship at the altar of intelligence alone. Intelligence alone is not enough if it is not in fusion with morality and ethics. The mind cannot stand alone without the heart.

The Colloquium is over, but it should continue in our hearts. We must—as individuals—continue to explore new concepts. We must—as individuals—continue to reach for new insights. We must—as individuals—continue to seek for answers in a world filled with questions. The opportunities are ours to take.

Thank you for coming. Thank you for sharing of yourselves. And, on a personal note, thank you for the gift you have given me—of yourselves, of your friendship.

Now, I look forward to seeing each and every one of you at Colloquium V. Until then, go forth, enjoy—and think.

**To: MERF, 2626 East 14th Street, Brooklyn NY 11235-3992** **(718) 934-3700**

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# MENSA 27

## RESEARCH JOURNAL

Hail to you, psychoneurotics,
For you perceive sensibility
        in the insensibility of the world,
        uncertainty in its certainty.
For you are often as conscious of others
        as of yourself,
For you feel the anxiety of the world,
        its limits and its false unlimited assurance . . .

For your fear of the absurdity of existence,
For your awkwardness,
        for your transcendental realism
        and your lack of daily realism . . .
For your creativity and your ecstasy,
For your maladjustment to what is
        and your adjustment to what ought to be,
For your immense possibilities not yet actualized . . .

For what is unique, original, intuitive and infinite in you:
For the solitude and the oddness of your paths.
Hail to you.

*K. Dabrowksi (1970)*

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# MENSA 27
## RESEARCH JOURNAL

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**Staff**:

*Editor* • Phyllis Miller, 23 Lexington Road, Somerset, NJ 08873

*Assistant Editor* • Mary Hollifield, 1104 Mary Lane, Fort Oglethorpe, GA 30742

*Circulation Manager* • Karolyn Silliman, 19340 Dunbridge Way, Gaithersburg, MD 20879

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# Editor's Preface

Every once in a while, a thinker comes along who is able to take all the pieces and put them together in a way that casts new light and opens new doors. Kazimierz Dabrowski is one of them.

In this issue, we present the work of several Americans who have studied the work of this Polish psychiatrist. They are part of an interdisciplinary study group formerly based at the University of Denver and now incorporated as the Institute for the Study of Advanced Development. The Institute publishes the journal *Advanced Development*.

When we asked them to send us material for an issue of the *Mensa Research Journal*, they responded with such an abundance of excellent, stimulating material that it was impossible to print it all. Those pieces that appear in this issue were selected primarily to provide an introduction to Dabrowski's work without totally overwhelming the reader, and I strongly encourage you to find out more about Dabrowski by writing to the Institute for the Study of Advanced Development, 139 East Florida Avenue, Denver, CO 80210. Tell them I sent you.

Meanwhile, start turning the pages and opening a few doors.

Phyllis Miller
Editor

# You, Creative Financial Planning, and MERF

In 1987, MERF's Board of Trustees approved a long-term development plan for strengthening and stabilizing its financial future. It provided for a new and major emphasis on the building of an endowment through the acquisition of "planned" and "deferred" gift support. Such gifts include bequests, paid-up or no longer needed life insurance policies, royalties, appreciated property such as securities and real estate, as well as an interesting variety of charitable trust and gift annuity arrangements.

In recent months, friends of MERF have expressed considerable interest in life income agreements. One that is particularly attractive is the Charitable Gift Annuity, which involves the transfer of cash or other assets to MERF in exchange for a guaranteed lifetime income paid out of income and principal.

Another type of life income plan is the Charitable Remainder Trust, whereby cash or other property is transferred to an independent trustee, such as a bank or trust company, and a stated income is provided the grantor, or someone she or he designates. The principal cannot be invaded and, by law, the return must be a minimum of five percent. In actuality, the return can be negotiated, with the age of the grantor being the major variable. It is only at the end of the contracted term that the remainder interest passes to MERF.

In both types of life income agreements, the grantor may designate the income to be directed to someone other than him or herself. Each kind can be funded with appreciated property, in which case there is no capital gain tax liability. Both plans are extremely flexible and can be adapted to a variety of personal circumstances. For example, the income can be deferred until retirement, or for when that grandchild attains college age. It can also be assigned to a spouse, handicapped child, or one's maiden aunt. One can even have the income paid for a term of years, rather than for life. With each of these split-interest, life income gifts, the donor-grantor gains an immediate and substantial income tax deduction for the discounted present value of that future gift to MERF. That is also true with a Life Estate gift, whereby one may give a farm or residence to MERF, while retaining for life the right to live in or use it.

These and other creative gift planning variations enable charitably motivated individuals to meet their own personal and family responsibilities, while furthering MERF's mission of research, education and service. To learn more about how MERF's creative gift planning programs can benefit you and your loved ones, and how your name and generosity can be permanently memorialized with an endowed gift, please contact MERF, Department T, 2626 East 14th Street, Brooklyn, NY 11235-3992.

# Dabrowski's Theory of Positive Disintegration*

*Karen C. Nelson*
*Emporia State University, Kansas.*

Hail to you, psychoneurotics,
For you perceive sensibility
    in the insensibility of the world,
    uncertainty in its certainty.
For you are often as conscious of others
    as of yourself,
For you feel the anxiety of the world,
    its limits and its false unlimited assurance . . .

For your fear of the absurdity of existence.
For your awkwardness,
    for your transcendental realism
    and your lack of daily realism . . .
For your creativity and your ecstasy,
For your maladjustment to what is
    and your adjustment to what ought to be,
For your immense possibilities not yet actualized . . .

For what is unique, original, intuitive and infinite in you.
For the solitude and the oddness of your paths.
Hail to you.

K. Dabrowksi (1970)

IQ tests give us one means of understanding and describing differences between individuals. But how do we understand and measure the quality of the differences we perceive between Klaus Barbie and Mother Teresa of Calcutta, between Dag Hammarskjold and Adolph Hitler? Kazimierz Dabrowski's Theory of Emotional Development—or Theory of Positive Disintegration (TPD) as Dabrowski called it to emphasize the role of suffering and inner conflict in advancing development — gives us a framework for understanding these qualitatively different levels of human development.

This article will describe Kazimierz Dabrowski and briefly summarize current research on his theory, TPD. Next, the main elements of TPD will be outlined and the concept of developmental potential (potential for advanced development) will be presented. Finally, TPD's implications for understanding and nurturing giftedness will be discussed.

*Reprinted from *Advanced Development Journal*, Vol. 1, Jan. 1989

## Kazimierz Dabrowski: His Life

Kazimierz Dabrowski (1902-1980) was a participant observer of two world wars, the Holocaust, the psychiatric office and the wards of mental hospitals. He was imprisoned for 18 months after World War II. (Ironically, the Nazis left him alone to care for his patients at a mental hygiene clinic just outside of Warsaw.) Besides being a therapist, he was a mental hospital administrator, a researcher and lecturer, a poet, musician and philosopher. From what he witnessed and experienced during a most terrible time in western history, he fashioned a vision of meaning about persons, a vision revealing a rich intelligence, a creative and courageous spirit. He did not confine himself to describing and studying persons who are average or "normal." His view was broad enough to explain the emotional impoverishment of the psychopath, the intensity of anxiety and despair that can be experienced by the self-aware, the bravery of the martyr and the tranquil selflessness of the saint.

A Polish clinician and theorist, Dabrowski held an M.D. in psychiatry and a Ph.D. in psychology. His formulation of TPD was based on personal experience, clinical practice as psychotherapist, and the study of gifted, creative and eminent individuals. The Theory of Positive Disintegration, he wrote, "grew out of events experienced in my adolescence and youth" (in Piechowski, 1975, p. 233). He learned about death early in life. When he was six, his three-year-old sister died of meningitis. As a teenager he observed a battle during World War I:

> When the exchange of artillery fire ended, fighting went on with cold steel. When the battle was over, I saw several hundred young soldiers lying dead, their lives cut in a cruel and senseless manner. (Dabrowski, in Piechowski, 1975, p. 233)

Questions of death, suffering, the meaning of human existence and the destiny of humanity arose for him not only because of the "suffering, death, and injustice inflicted upon persons very close to me" but also because of the "suffering, imprisonment and death of great numbers of people" (Dabrowski, in Piechowski, 1975, p. 233). He witnessed "masses of Jewish people herded toward ghettos. On the way, the weak, invalid and sick were ruthlessly killed" (p. 233). Hitler's death camps for Europe's Jews were built on Polish soil. Of this period Dabrowski wrote, ". . . many times, I myself and my close family and friends have been in immediate danger of death" (p. 234). He observed,

> The juxtaposition of inhuman forces and inhuman humans with those who were sensitive, capable of sacrifice, courageous, gave a vivid panorama of a scale of values . . . Superficiality, vulgarity, absence of inner conflict, quick forgetting of grave experiences, became something repugnant to me. I searched for people and attitudes of a different kind, those that were authentically ideal, saturated with immutable values, those who represented "what ought to be" against "what is." (p. 234)

Dabrowski found great creative and developmental richness in clients who consulted him for psychoneurotic symptoms and even among those manifesting psychotic disorders. He saw in these persons' lack of reconciliation to their social reality a sensitivity to reality of a higher order. His clinical practice revealed a link between psychoneurotic and creative processes. Detailed biographical study of mankind's geniuses and saints added further to his observation that psychoneurosis and even borderline psychosis frequently seemed to combine with high-level moral and creative functioning and advanced emotional development (Dabrowski, 1964, 1967; Dabrowski, Kawczak & Piechowski, 1970; Dabrowski & Piechowski, 1977).

## Research on TPD

Dabrowski first published articles of his ideas in 1937 and 1938. The invasion of Poland in 1939 eliminated the possibility of research or publication until after the war. In 1948 an article on positive disintegration appeared. Because of difficult post-war conditions in Poland, a book-length formulation of the theory was not permitted to be published until 1964. During the 1960s and 1970s Dabrowski lectured and taught in various North American universities. In 1969, when Dabrowski was on the faculty of the University of Alberta, a grant from the Canada Council made possible the first empirical study of the theory (Piechowski, 1975, p. 267).

Although TPD draws the interest of an international group of therapists and scholars, it began to receive attention from American researchers in the late 1970s especially after articles on aspects of the theory appeared in *New Voices in Counseling the Gifted* (Colangelo and Zaffran, 1979). Several methodological studies have been conducted to develop, refine and analyze two essay questionnaire instruments as tools for study of the theory: the Definition Response Instrument (DRI) and the Overexcitability Questionnaire (OEQ). Piechowski developed the Overexcitability Questionnaire to assess the strength of the overexcitabilities (OEs). It was later refined by Lysy and Piechowski (1983). (These constructs are explained later in this article.)

Gage, Morse and Piechowski (1981) developed the DRI, a research instrument for assessing levels; they used a multi-trait, multi-method technique to establish the construct validity of levels. Miller and Silverman (1987) reported on a content analysis rating system created, tested and recommended for analyzing responses to the DRI. Brennan (1987) has utilized an intensive case study approach and Piechowski (1978) and Piechowski & Tyska (1982) have conducted biographical analyses to identify individual growth and potential as defined by the theory.

Those doing research on gifted children and adults have become interested in the theory because TPD goes far beyond the IQ, the traditional identification measure of giftedness. TPD offers a paradigm for assessing, understanding and nurturing the personality variables associated with high ability and advanced development (Piechowski, 1986). Most research of the last decade has looked at the theory's conception of developmental potential (Gallagher, 1985; Lysy & Piechowski, 1983; Piechowski, 1979, 1986; Piechowski & Colangelo, 1984; Piechowski & Cunningham, 1985; Piechowski, Silverman & Falk, 1985; Robert & Piechowski, 1981; Schiever, 1985; Silverman, 1983; Silverman & Ellsworth, 1981).

## The Theory of Positive Disintegration

Clinical practice convinced Dabrowski the Freudians were mistaken in attributing adult neurosis to childhood events. He was no better satisfied with the behaviorist view of human nature. He did not think results gained by experimentation with animals transposed to the complexity and subtlety of human psychology. Nor did he find a fit with Adlerian theorists. They did not "take into account the developmental potential of the inner psychic milieu" (Piechowski, 1975, p. 235).

Dabrowski's TPD, unlike most other empirically derived psychologies of persons, does not interest itself in discovering a hypothetical "norm" or average of human behavior. Dabrowski was interested in describing human personality as it actually exists and in the developmental process from "what is" to "what ought to be." He observed what he called a multilevelness in human behavioral phenomena. Love, for example, at one level might mean the selfish use of another as an object to gratify one's needs or desires. Love, at another level, might mean selflessly giving one's life so another can live. Fear, to cite another example, can be primitive and immobilizing, the result of stimuli in the external environment. Or fear can be "existential," the result of reflecting on one's mortality, or the meaning of one's existence. Existential fear results from inner sensitivity and suffering, not external stimuli as such.

Dabrowski observed that these disparate behavioral manifestations of a phenomenon (such as love or fear) did not seem to occur in the same individual. He began to see behaviors as ranking from egocentric, at one end of a continuum, to altruistic, at the other end; from nonreflective with no apparent inner life, to intensely self aware; from a developmental (seemingly not capable of psychological growth) to highly developed with maturely evolved psychological structures.

Piagetian developmental theorists have emphasized cognitive development, with little attention for the role of emotions in development. Dabrowski's TPD emphasizes the affective aspect of development. It attempts to explain, not just describe, developmental transformations as a sequence of five levels. Each level constitutes a distinct personality structure or behavioral organization. The emotional forces which distinguish the levels are called dynamisms to indicate their dynamic potency to promote development. Developmental potential is the underlying principle that provides continuity between the levels. Each level represents an advancement over the last level. Transformation is from simple to complex, from the most automatic to the most voluntary (Piechowski, 1975).

Dabrowski observed that the most gifted and creative individuals with whom he worked seemed to exhibit higher levels of empathy, sensitivity, moral responsibility, self-reflection and autonomy of thought than the general population. During times of crisis these same individuals exhibited so-called neurotic symptoms—intense inner conflict, feelings of inferiority toward their own ideals, feelings of inadequacy, shame and guilt, and existential anxiety and despair. Dabrowski suggested that such individuals were "positively maladjusted." They had evolved beyond the societal norm and experienced great pain in the awareness of their differences from the norm. Because of the suffering and distress that accompanied growth or developmental transformation, Dabrowski called it positive disintegration—a process whereby simpler and less mature psychological structures composing the personality break down in order for more complex and advanced structures to arise.

Dabrowski not only observed that the inner conflict generated by the disintegration process was necessary for the attainment of higher levels of human functioning, he also concluded that most persons do not attain these higher levels. Most persons are egocentric and unprincipled, or they are crowd followers, lacking an integrated set of inner values. As noted above, Dabrowski postulated five qualitatively different levels of human development, each with a distinguishable personality organization.

### Level I: Primary Integration

At Level I, Primary Integration, egocentrism prevails. A person at this level lacks the capacity for empathy and self-examination. When things go wrong, someone else is always to blame; self-responsibility is not a Level I characteristic. With nothing within to inhibit personal ambition, Level I individuals often attain power in society by ruthless means.

An example might be an arms dealer such as General Secord who will promote war in both Iran and Nicaragua for the sake of the millions of dollars of profit to be gained. Never is the question of the resulting death and destruction an issue to be considered—personal material gain is primary. There appears to be no anguish over the conflict between greed and the less tangible value of human life. Dabrowski observed that political and social leaders often come from this developmental strata.

### Level II: Unilevel Disintegration

Level II individuals are influenced primarily by their social group and by mainstream values or they are moral relativists for whom "anything goes," morally speaking. They often exhibit ambivalent feelings and indecisive behavior because they have no clear-cut set of self-determined internal values. At Level II, called by Dabrowski Unilevel Disintegration, inner conflict is horizontal, a competition between equal, competing values.

Anna Karenina, heroine of Tolstoy's novel by that name, is an example of unilevel disintegration. Anna is torn between her emotional needs for her lover, Count Vronsky, and her dependence on her dispassionate husband and the conventional morality that insists she stay with him. Anna's conflict is intensified when she becomes pregnant with Vronsky's child and her husband lets her know she cannot take their son with her when she goes to Vronsky. She cannot give up her lover to be a faithful wife. Nor can she cast her lot solidly with Vronsky when she leaves her husband. She misses her son so intensely that she is drawn back to her former home for secret visits with him.

Anna's inability to resolve the conflicts between her needs and loyalties destroys her happiness with Vronsky and makes her unable to adequately mother their daughter. She finally ends her suffering by impulsively throwing herself in front of a train. Anna is unable to respond to the suffering she experiences in a way that will propel her towards the transformations of multi-level or advanced development. She cannot sort out for herself a hierarchy of values that distinguishes "what is" from "what ought to be." Her situation is tragically difficult, true, but she seems to lack the inner resources (or developmental potential) for the task.

### Level III: Spontaneous Multilevel Disintegration

At Level III, multilevelness arises. The person develops a hierarchical sense of values. Inner conflict is vertical, a struggle to bring one's behavior up to higher standards. There is a dissatisfaction with what one is, because of a competing sense of what one could and ought to be (personality ideal). This internal struggle between higher and lower can be accompanied by existential despair, anxiety, depression and feelings of dissatisfaction with the self (inferiority, disquietude, astonishment).

Traditional psychologies often interpret the affect exhibited at Level III as symptomatic of a psychoneurosis that must be "cured" so the individual can lead a "normal" life. Dabrowski (1972) disagreed. He insisted that psychoneurosis is not an illness. If there are symptoms of breakdown, they can be signs of positive disintegration in which simpler, more instinctual psychological structures are being replaced by more complex and conscious (voluntary) structures. Personality ideal is arising; personality is evolving in the direction of the ideal.

Whereas individuals at Level II are content with mainstream values of the family, church and society, at Level III one senses, "No one else is going to tell me what truth is, what life means. No one can tell me what my life means. Is there a God? Am I here for a purpose? What purpose?" The Level III personality does not idly contemplate these questions as abstract issues. He or she feels them in the soul. Not knowing answers can be anguish. When the soul finds its answers, they compel response from the life. Dabrowski and Piechowski (1977) consider Dostoievsky's *Crime and Punishment* a demonstration of the Level III rift between higher and lower values. Tolstoy himself is used as an example of Level III development by Marsh and Colangelo (1983). Dostoievsky and Tolstoy expressed their own multilevel conflicts in their compelling novels.

March and Colangelo suggest that Leo Tolstoy exemplified Level III because of the evidences of multilevel disintegration:

> Tolstoy's ideal of the simplification of life was a unifying philosophy of his life, but it also led him into constant bickering with himself and his family over the variance between the ideal and their daily lives. His life was fraught with conflict concerning his moral principles and ideals . . . Tolstoy's dominant characteristic is disin-

> tegration, characterized by inner conflict and discontent with his life in relation to his ideas, existential anxieties, and suicidal tendencies. In addition to these conflicts, Tolstoy also evidenced an emerging hierarchy of values, a deepening empathy, awareness of moral responsibility, and self-evaluation. (p. 219,233)

Another key to advanced development, as significant as multilevelness, is Dabrowski's concept of the autonomous factor. Heredity and environment govern Levels I and II, but for Level III development to be possible, a person must be able to assert self-awareness, self-direction and self-discipline to overcome genetic propensities, upbringing and external circumstance. The autonomous factor is a will to grow through inner psychic transformation. A sense of responsibility—not only for one's actions, but also for one's development—characterizes advanced development. The autonomous factor is a powerful force propelling development toward higher levels of integrity and authenticity. Level III individuals can envision what they would like to be, but they do not yet hold the means of meeting their own ideals.

### Level IV: Organized Multilevel Disintegration

In comparison to Level III, which he called Spontaneous Disintegration (the level of emotional tumult), Dabrowski called Level IV Organized Multilevel Disintegration. Level IV individuals are well on the road to self actualization. They have found a way to reach their own ideals and they are effective leaders in society. They show high levels of responsibility, authenticity, reflective judgment, empathy for others, autonomy of thought and action, self-awareness and other attributes associated with self actualization.

On the basis of evaluation of extensive biographical material, Piechowski (1986) concluded that Eleanor Roosevelt is an example of at least Level IV development.

Eleanor Roosevelt's life is an example of self actualization (Piechowski & Tyska, 1982). The extent and power of her compassion, and the deliberate effort to follow Christ as her inner ideal, reveal in her development characteristics that go even higher, technically speaking from Level IV to Level V.

Just as William James described moral action as the

> effort of will in line of greatest resistance, so did she at each point of emotional resistance in her struggle for self-mastery. That was the principal goal through the first half of her life; later it was the service to her country and the whole world (human rights and peace). (p. 194)

### Level V: Secondary Integration

At Level V the struggle for self-mastery has been won. Inner conflicts regarding the self have been resolved through actualization of the personality ideal. Dabrowski called this the level of Secondary Integration. Disintegration has been transcended by the integration of one's values and ideals into one's living and being. The life is lived in service to humanity. It is lived according to the highest, most universal principles of loving, compassionate regard for the worth of the human individual.

As an example, think of the life of Mother Teresa of Calcutta. Self-concerns are transcended. British journalist Malcolm Muggeridge (1971) begins his book about her by saying, "Mother Teresa has requested that nothing in the nature of a biography or biographical study of her should be attempted" (p. 15). He goes on to explain:

> It is, of course, true that the wholly dedicated like Mother Teresa do not have biographies. Biographically speaking, nothing happens to them. To live for, and in others . . . is to eliminate happenings, which are a factor of the ego, and the will . . .
>
> There is much talk today about discovering an identity, as though it were something to be looked for, like a winning number in a lottery, then, once found hoarded and treasured. Actually, on a sort of Keynesian principle, the more it is spent the richer it becomes. So, with Mother Teresa, in effacing herself, she becomes herself. I never met anyone more memorable. (p. 16)

Of her empathy, her love, her sense of the significance of each individual, Muggeridge writes:

> What the poor need, Mother Teresa is fond of saying, even more than food and clothing and shelter . . . is to be wanted. It is the outcast state their poverty imposes upon them that is the most agonizing . . . I never experienced so perfect a sense of human equality as with Mother Teresa among her poor. Her love for them, reflecting God's love, makes them equal, as brothers and sisters within a family are equal, however widely they differ in intellectual and other attainments . . . (pp.22-23)

## Developmental Potential

How do we explain why so many persons do not evolve emotionally beyond Levels I and II? What are the indicators of potential for advanced development? Dabrowski's concept of developmental potential gives guidelines for answering these questions. Dabrowski found that five types of "increased psychic excitability" were predictive of developmental potential. He called these overexcitabilities (OEs). They are assumed to be part of a person's constitution and to be more or less independent of each other. Piechowski (1979) has provided an in-depth description of the overexcitabilities and suggested how they might be used to identify the gifted. The following synopsis is from Piechowski's elaboration of Dabrowski's OEs.

> If more than one of these channels, or all five, have wide apertures, then the abundance and diversity of feeling, thought, imagery, and sensation will inevitably lead to dissonance, conflict and tension, but at the same time it enriches, expands, and intensifies the indi-

> vidual's mental development. At times the inner tensions and conflicts may be overwhelming. Still, the process of development must go on—an arduous passage from a lower to higher level—from external to internal control, from impulse to reflection, from sociability to empathy and compassion, from social norm to the norm of the ideal, from relative to universal values, from competition to service to others, from possessive and security-seeking love to all-embracing love. (p. 29)

The OEs are the building blocks of the levels: The greater their number and intensity, the greater the developmental potential.

## Overexcitabilities

Psychomotor overexcitability is expressed as high degrees of energy, activity and movement. It manifests as love of movement, rapid speech, pursuit of intense physical activity, pressure for action, impulsiveness, and restlessness. Sensual overexcitability involves an intensity and craving for pleasure, a "keen sensual aliveness" (Piechowski, 1986, p. 190) to sights, smells, tastes, textures and sounds. Sensual OE can be expressed in seeking sensual outlets for inner tensions, especially through overeating and varieties of sexual experience.

Intellectual overexcitability includes questioning, questing, analysis, problem solving, theoretical thinking, and the capacity for sustained intellectual effort. It is not synonymous with intelligence, since many intelligent individuals do not derive great pleasure from intellectual pursuits. Imaginational overexcitability is vivid imagery, invention, and the capacity for creative imagination. It can be recognized through rich association of images and impressions, animated visualization, use of image and metaphor in verbal expression, predilection for fantasy and ability to retell dreams in vivid detail.

Manifestations of emotional overexcitability include intensity of feeling, inhibition, strong affective memory, concern with death, anxieties, fears, guilt, depression and suicidal moods. Most notable of the emotional OEs are relationship feelings; richly differentiated interpersonal feeling "is the mainstuff of individual development from a lower to a higher level" (Piechowski, 1979, p. 38). Research done to date on the overexcitabilities has demonstrated that emotional OE, usually in combination with heightened intellectual OE, is the most significant of the OEs for indicating strong potential for advanced development (Lysy & Piechowski, 1983).

## Implications for the Gifted

Dabrowski's TPD provides a theoretical framework for understanding human development that is sufficiently broad to account for the highly differentiated development of gifted, creative and talented persons. For those whose emotional intensity can range from anguish to ecstasy, to learn of Dabrowski's idea of positive disintegration can be a homecoming. A teacher said recently after hearing a presentation of

TPD, "My 22-year-old daughter has been going through a tough time emotionally. Last night after hearing about Dabrowkski, I explained the theory to her and the concept of multilevel disintegration. It was a help to her. She said it made her feel there might be some purpose to the turmoil she is undergoing. The thought that it might lead somewhere gave her hope."

Parents and teachers of the gifted can find TPD useful as a framework for understanding and explaining the developmental patterns and challenges which occur for those of high ability.

> It helps to find out someone else studied and made sense of a manner of feeling and acting that is often at odds with the cool norm and expectations of the herd. It helps for once to feel legitimate in one's extraordinary reactions (Piechowski, 1986, p. 191).

To hear that psychoneurosis is not illness can help the intensely sensitive make meaning of their experience of life. A novelist who is a Mensan said, "I experience intense despair over disappointments in relationships. I sometimes have terrible anxiety attacks. I feel at times even my own family must think I'm weird." After hearing of Dabrowski's ideas, he went on to say, "I know I could take pills to lower the anxiety, but I don't. They would also reduce the sensitivity to people, to feelings and to life that makes me able to write my books. It is worth the downside, but it is never easy . . ."

Ogburn Colangelo (1979) suggests that TPD offers us a unique perspective for counseling gifted individuals, a perspective that leads us "to act as nurturers, not so much of the talent itself, but of the emotional structure from which the talent comes" (p. 186). She includes a tapescript of a session with a gifted counselee in which the counselor perceptively and sensitively supports and reframes the young woman's emotional overexcitability and multilevel dynamisms.

Silverman (1987a) also offers suggestions for using TPD in counseling the gifted to come to accept and value their emotional intensity, their unique perceptions and maladjustment to "what is." She emphasizes how important it is for the counselor to respect the potential that inner conflict holds for personal growth and emotional development, rather than seeing inner conflict simply a problem to be resolved.

TPD's concept of developmental potential vis a vis the overexcitabilities is of particular relevance to educators and researchers in the fields of gifted education and moral leadership because it provides a basis for identifying, assessing and nurturing extraordinary developmental gifts. Research findings indicate that giftedness tends to correlate with an elevated OE profile and that a broader range of giftedness tends to correlate with an elevated OE profile than is identified with traditional IQ measures (Piechowski, 1979; Piechowski, 1986; Piechowski & Colangelo, 1984). Dabrowski observed that political leaders tend to be Level I personalities. How much our world needs more leaders like Eleanor Roosevelt and Mother Teresa, or like Gandhi, Martin Luther King, Jr., Dag Hammarskjold, or Anwar Sadat. TPD gives us a basis for identifying this kind of potential and encouraging it.

> If we want moral leaders, we need to nurture the soil wherein the leadership grows. That soil is emotional intensity and inner conflict. It is only through dealing with emotionally charged issues that individuals learn what they really believe in and confront those parts of themselves they wish to change. (Silverman, 1987b, p.2)

And finally, the theory seems to hold particular promise for a nonsexist or gender-fair understanding of advanced potential because it does not emphasize accomplishment and eminence (e.g., number of research articles published, professional or financial status—measures which disadvantage women) at the expense of qualities such as empathy, sensitivity, altruism and integrity. In the 1955 follow-up of Terman's classic longitudinal study of the gifted, female subjects fared poorly by comparison with their male counterparts. Yet both groups had been equally bright, equally promising when Terman tested them in childhood at the beginning of the study. By 1955, when the group had reached midlife, the contrast between the genders was startling. Male salaries, for example, ranged from $50,000 to over $400,000. By comparison, the 50 percent of the sample of gifted females who were employed earned from less than $3,000 to a high of $24,000 (for a woman physician).

Another of the measures of success employed to compare the groups showed that only seven of the women, compared with 70 of the men, were listed in *American Men of Science.* Apparently at a loss for how to deal with these disparities, the research teach which conducted the 1955 follow-up of the Terman group decided to leave women out of their interpretation of the "success" of the group "because of the lack of a yardstick by which to estimate the success of women" (Kerr, 1985, p. 12). What if Dabrowski had been asked to evaluate the Terman Group, by TPD's yardstick of OEs and multilevel dynamisms? The women, one can at least speculate, would have fared much better.

## Conclusion

If you are captivated by the pursuit of happiness or the desire to be well adjusted, the goals of advanced development are probably not within your line of vision. The wellspring of human gifts, called developmental potential in TPD, is rich and deep. But those who are "gifted" in the Dabrowskian sense are not in for an easy life. Advanced development has to do with recognizing and admiring a universal principle such as justice, and then growing to the point where you do justice. You do justice, not only because it is right but more so because you cannot do otherwise. You don't belive one thing but find yourself doing another; you become a just person.

For a final example of this principle of advanced development, think of Soviet physicist Andrei Sakharov, a human rights activist. Doing justice by protesting injustice has carried a heavy penalty for Sakharov. Lidia Chukovskaya (1982) wrote to him in Gorky, where he was in exile, on his 60th birthday:

> They have deprived you of your government awards, they have deprived you of scientific and personal contacts. They have taken away everything that constituted the essence of your life: diaries, reflections about the past and future, scientific projects . . . As Leo Tolstoy pointed out, spiritual strength can be suppressed only until "it reaches the highest stage, at which it is more powerful than everything." The spiritual force radiated by you is growing, and cannot be taken away along with your papers. (p. 3)

Another Russian, Grigorii Pomerants (1982), wrote that he did not believe the human rights movement could yield any political results in Russia. But he went on to say of the activists:

> What they are doing is hard to justify in terms of outer expediency. But in their hopeless cause there is something else besides the impossibility of political success: the possibility of remaining a human being—a step toward what Dosteyevsky called a strongly developed personality. Before our eyes arose a kind of all-inclusive Leo Tolstoy, with his "I cannot remain silent." Thus there grew before our eyes Andrei Dmitriyevich Sakharov, losing his position, money, work, and outer freedom. He grew, and he remained each person's equal. No one is oppressed by his worldwide shadow. (p. 47)

In summary, Kazimierz Dabrowski's Theory of Positive Disintegration contributes a conceptual framework that gives structure and substance to the idea of advanced development. At times Dabrowski drew from his observations and experiences of humankind's political and social behaviors, including the extremes of facism, genocide, and war. At times he drew from his perceptions of individuals' aesthetic sensitivities or the ethical and existential dilemmas of the inner life. As Dabrowski described it, the evolution of a personality is an autonomous intrapersonal process of sensing and then reaching for and becoming something (someone) larger and truer.

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# The Concept of Developmental Potential*

*Michael M. Piechowski, Northland College, Ashland, Wisc.*

There exist important personality characteristics of the gifted and talented that intelligence tests do not tap. Among these characteristics is a broad range of a heightened activity which finds expression in an enlarged and intensified manner of feeling, thinking, imagining, even tasting. The model of developmental potential defines five dimensions of such enhanced mental functioning. These five dimensions provide a broader conception of the makeup of giftedness and talent. The model offers new means of examining commonly used methods of identification; it also offers ways of recognizing potential for self-actualization and outstanding moral development.

Giftedness is a multifaceted phenomenon involving the interplay of specific talents, favorable environmental events, and unique personality characteristics. The traditional emphasis in gifted education has been on the identification of students with higher cognitive potential as measured by standardized intelligence and achievement tests. Personality variables readily observable in creative and gifted adults (Barron, 1963; Tannenbaum, 1983) are rarely taken into account in either identification of gifted students or programming on their behalf.

Intelligence testing as the major criterion variable for program selection fails to provide sufficient information about the personality characteristics that distinguish between gifted and average individuals. Further, intelligence tests offer no theoretical models for development of talent. The concept of developmental potential offered in this paper broadens the conception of giftedness by addressing the personality correlates of high ability. This model also suggests a method of identifying individuals with high potential beyond the traditional IQ tests, and binds the goals of their education to self-actualization and advanced moral development, rather than merely to productivity in adult life.

It is often recognized that gifted and talented people are energetic, enthusiastic, intensely absorbed in their pursuits, endowed with vivid imagination, sensuality, moral sensitivity, and emotional vulnerability (Barron, 1963; Goertzel, Goertzel, & Goertzel, 1978; Hollingworth, 1942). What has been lacking is a model that would offer a way of integrating these universally observed traits with the nature and development of talent. Are these characteristics a part of the high IQ package, are they specific to talent, or are they properties of the personality of the talented individual?

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These characteristics are found across different talents, in writers, composers, dancers, actors, scientists, inventors, civic and spiritual leaders. Often they are as strong in adulthood as in childhood. Do they aid or impede development? For example, Bachtold (1980) pointed out the emotional intensity and sensitivity in women writers. We can find similar examples in male scientists. Louis Pasteur, in spite of his ardent desire for knowledge, suffered despair and acute homesickness when he went to attend school in Paris (Vallery-Radot, 1923). The mathematician Norbert Wiener (1953) as a child was subject to many fears: of death, of injury, of darkness, of violence, of his father's voice. He was subject to feelings of terror. He was extremely sensitive to cruelty and injustice. Juan de Dios, the founder of the Hospitallers in 16th-century Spain, pretended to be insane in order to share the lot of the inmates of the insane asylum. After eight months the compassion for the beatings and agonies he witnessed brought on him such intense anguish that his spiritual director ordered him to leave the asylum (Newcomb, 1959). Eleanor Roosevelt (1937) as a child was terrified when a thief jumped onto a streetcar she was riding, but later "the face of that poor haunted man was too vividly before me, and it continued to come before me in my dreams for months afterwards." These examples show the enduring quality and the intensity of such emotions, a manner of experiencing in a higher key.

A somewhat different manner of enhanced experiencing is present, for example, in Norbert Wiener's vivid memory of smells and tastes from his childhood trip to Vienna: "The smell of the alcohol lamp over which my parents prepared my sister's warm evening meals, the smell of the rich European chocolate with whipped cream, the smell of the hotel and the restaurant and cafe—all these are still sharp in my nostrils." There is here a keen sense of aliveness.

## Five Dimensions of Psychic Life

This amplified range of different experiential channels found in creative people as well as in those who seek spiritual perfection was correlated by Dabrowski (1964) with intensified personal growth. People with less fire in their veins look upon those who have it as different, abnormal, neurotic. They avoid having such people as friends because they can neither understand nor appreciate them. If they could they would willingly avoid having such children. When we do not understand someone's behavior we label it irrational regardless of the hidden causal chain. When someone's extraordinary sensitivity, altruism, or fantasy break the norms we regard such behaviors as abnormal and label them as neurotic. To Dabrowski, however, the label was hiding something highly significant—signs of a richer psychological endowment. He found that in youth with superior intellectual and artistic abilities a greater number of so-called neurotic symptoms (anxiety, extreme fluctuation of mood, fixed ideas, obsessions, compulsions, psychosomatic ailments) correlated with a greater number of indices of enhanced modes of experiencing. He concluded that "nervousness and psychoneuroses are phenomena normal in the course of Development" (Dabrowski, 1972). He saw these as signs of developmental potential.

Dabrowski's concept of developmental potential included talents and abilities, plus five primary components: psychomotor, sensual, intellectual, imaginational, and emotional. Conceived broadly as five dimensions of psychic life, these components have many possible expressions: psychomotor (P)—movement, restlessness, drivenness, an augmented capacity for being active and energetic; sensual (S)—enhanced differentiation and aliveness of sensual experience; intellectual (T)—avidity for knowledge, discovery, questioning, love of ideas and theoretical analysis, search for truth; imaginational (M)—vividness of imagery, richness of association, facility for dreams, fantasies and inventions, animisms and personifications, liking for the unusual; and emotional (E)—great depth and intensity of emotional life expressed in a wide range of feelings, compassion, attachments, heightened sense of responsibility, self-examination. Without some degree of intensity in these areas, talent is mere technical facility lacking heart and fire.

These five dimensions may be thought of as channels of information flow and as modes of experiencing (Piechowski, 1979). They can be wide open, narrow, or barely present. Dabrowski called them "forms of psychic overexcitability" to underline the enhancement and intensification of mental activity, much beyond the ordinary. Overexcitabilities contribute to the individual's psychological development, and so their strength is taken as a measure of developmental potential.

When gifted people, or their parents, are introduced to these concepts there is often an instant recognition and a reaction of relief. It helps to find out that someone else studied and made sense of a manner of feeling and acting that is often at odds with the cool norm and expectations of the herd. It helps for once to feel legitimate in one's extraordinary reactions. It helps to learn that one does not have to be dead or famous to be allowed what one cannot help experiencing. The stronger these overexcitabilities the less welcome they are among peers and teachers. Such children feel different, apart from others, guilty and embarrassed for being different. Criticized or teased for what they cannot help, they feel there is something wrong with them. Sometimes they learn to disguise it, sometimes they seek refuge in fantastic worlds of their own creation, sometimes they try to "normalize" it and suffer in consequence the agonies of those who deny their own potential (Maslow, 1971).

The concept of developmental potential finds its application in two research directions. The first is descriptive, a study of the range and the strength of expressions of overexcitabilty in gifted and talented individuals. This direction has important implications for investigating the nature of giftedness and talent and the basis for methods of identification. The second is the study of advanced forms of individuation exemplified by self-actualizing people, moral leaders, humanitarians and saints. It is from this direction that the developmental potential gains its meaning as potential for higher levels of development.

## Developmental Potential as Descriptive of Gifted and Talented

Systematic investigation of the five forms of overexcitability was made possible by the Overexcitability Questionnaire (OEQ). In its current form it consists of 21 open-ended items (Lysy & Piechowski, 1983). The items are designed to elicit material corresponding to the expressions of OE listed in Table 1.

Several comparative studies have been conducted. Silverman and Ellsworth (1981) compared OE profiles of intellectually gifted adults and a heterogeneous sample of graduate students. The two groups differed strongly on four of the five OEs. The intellectually gifted showed much higher scores on sensual, intellectual, imaginational, and emotional OEs. Of particular interest was the finding of strong emotional OE among the intellectually gifted because it underscores the importance of emotional endowment in the makeup of intellectually gifted persons.

In another study the intellectually gifted adults and a sample of graduate students were compared with artists (Piechowski, Silverman and Falk, 1985). Except for intellectual OE all the other OEs are more strongly represented in the artists than in the intellectually gifted. Their imaginational and emotional OEs are by far the strongest. Their intellectual OE score is not significantly different than that of the gifted. This is in agreement with other researchers (Eiduson, 1958; Getzels & Csikszentmihalyi, 1976; Roe, 1946) who found in artists strong preference for complex, abstract and theoretical thinking. Their high imaginational OE score reflects the creative element that goes much beyond the concept of divergent thinking. It includes magical and animistic thinking, vivid visualization of fantasized scenes, the ability to go back to an interrupted dream, interest in psychic phenomena (Davis, Peterson, & Farley, 1973; Wilson & Barber, 1983), and more. The artists' high emotional OE score has a broader meaning. It confirms Langer's (1967) view of the artist as an expert in the knowledge of subjective life. Art and the humanities are devoted to the formulation and expression of that which is most deeply felt in human experience. Every form of human creation is valued and cherished as an expression of the inexhaustible capacities of the human spirit. In that lies the universality and the emotional significance of art, poetry, music.

Having found different OE profiles in distinct groups one may ask whether differentiation of such profiles can exist within a group. A study of artists (Piechowski & Cunningham, in press) revealed the possibility of finding several OE patterns within that group; pattern A with strong, balanced OEs, pattern B with emotional overexcitability and sensitivity so dominant that it pervaded all other OEs, and pattern C with lower emotional OE but the remaining ones unharmonized, strident, restless, and driven. These types of subgroup and individual differences offer a means of studying the direction of development that gives rise to a particular form and tone of artistic expression. The difference between academic art and art pulsating with life may well be the difference between OEs that only trickle and OEs with the power of geysers.

## TABLE 1
## Forms and Expressions of Psychic Overexcitability

### PSYCHOMOTOR

- Surplus of energy
  - rapid speech, marked enthusiasm, fast games and sports, pressure for action, delinquent behavior
- Psychomotor expression of emotional tension
  - compulsive talking and chattering, impulsive actions, delinquent behavior, workaholism, nervous habits (tics, nailbiting)

### SENSUAL

- Sensory pleasures
  - seeing, smelling, tasting, touching, hearing
- Sensual expression of emotional tension
  - overeating, masturbation, sexual intercourse, buying sprees

### INTELLECTUAL

- Probing Questions
- Problem Solving
- Learning
  - curiosity, concentration, capacity for sustained intellectual effort, extensive reading
- Theoretical Thinking
  - thinking about thinking, introspection, preoccupation with certain problems, moral thinking and development of a hierarchy of values, conceptual and intuitive integration

### IMAGINATIONAL

- Free play of the imagination
  - illusions, animistic and magical thinking, image and metaphor, inventions and fantasy, poetic and dramatic perception
- Spontaneous imagery as an expression of emotional tension
  - animistic imagery, mixing of truth and fiction, dreams, visual recall, visualization of events, fears of the unknown

### EMOTIONAL

- Somatic expressions
  - tense stomach, sinking heart, flushing
- Intensity of feeling
  - positive feelings, negative feelings, extremes of feeling, complex feelings, identification with others' feelings
- Inhibition (timidity, shyness)
- Affective memory
- Concern with death
- Fear and anxiety
- Feeling of guilt
- Depressive and suicidal moods
- Relationship feelings
  - need for protection, attachment to animals, significant others, perceptions of relationships, emotional ties and attachments, difficulty of adjustment to new environments, loneliness, concern for others (empathy), conflict with others
- Feelings toward self
  - self-evaluation and self-judgment, feelings of inadequacy and inferiority

Several studies examined OE profiles in children and adolescents. Gallagher (1985) compared gifted and nongifted 11- and 12-year-olds, and Schiever (1985) compared youngsters that were high and low on a creativity measure. Both studies found higher OE profiles in the gifted and the creative than in the low-creative and nongifted.

Age-related changes in OE scores were tested between the ages of 9, 11, and 13. (Age nine appears to be the lower limit for using OEQ). As currently assessed with an expanded weighting scale the rise in OE scores is greatest for imaginational, intellectual and emotional OEs between the ages of 11 and 13 (Piechowski, unpublished). Most likely, this reflects increasing skill in verbal and written expression rather than an increase in the strength of the OEs themselves.

Sex-related differences were noted in the same study in emotional OE. Girls tend to produce higher emotional OE scores than boys. Thus, in comparing different samples it is important to know the sex ratio because the higher the ratio of boys to girls the lower the mean emotional OE score. All these studies report similar OE scores on different samples and similar OE values for a given age.

In a study of a larger pooled sample of gifted adolescents (N = 138), Piechowski and Colangelo (1984) found a bimodal distribution in regard to intellectual OE. The interesting feature of this finding was that there were no significant differences between the high and the low intellectual OE groups in regard to the remaining OEs. However, in the comparison group of graduate students, low intellectual OE score went together with lower other OE scores. Thus giftedness tends to correlate with an elevated OE profile. The reverse, i.e., that an elevated OE profile is a sign of giftedness, should also hold true, but as yet it has not been put to the test.

Identification procedures vary widely (Richert, Alvino, McDonnel, 1982). In the study by Piechowski and Colangelo (1984) gifted adolescents were recruited from several different high schools. One school appeared to be selecting primarily hardworking, task-oriented achievers (but let us not disparage them, they are much needed). Another high school was selecting a large proportion of creative, self-directed, and imaginative youngsters, as judged by the content of their responses on the OEQ. By contrast, the first school seemed to select against this type of youngster.

The OEQ thus offers a new possibility of investigating identification procedures. On the assumption that the stronger, overall OE profile the stronger the talent, the OE profile offers the opportunity of identifying a broad range of giftedness (Piechowski & Colangelo, 1984). The popular Renzulli-Hartman (1971) scale was given a tentative scrutiny in terms of the overexcitabilities (Piechowski, 1979). At that time it had only four subscales: learning, motivation, creativity and leadership. Except for the leadership subscale, intellectual items dominated the other three scales. Even on the creativity subscale, items expressive of imagination and feeling took second place to the intellectual ones. What remains to be done is to see what are the OE profiles of gifted youngsters identified by means of this and other similar instruments.

## Developmental Potential as Potential for Self-Actualization and Moral Vigor

William James (1890) observed that moral action—the action of following one's ideals—is "action in the line of greatest resistance." To follow one's ideals one has to overcome the resistance of one's lower inclinations, but when one follows the latter the ideals are not resisting: "If in general we class all springs of action as propensities on the one hand and ideals on the other, the sensualist never says of his behavior that it results from a victory over his ideals, but the moralist always speaks of his as victory over his propensities." James also noted that individuals for whom moral questions demand not mere intellectualization but a response in action, are intensely emotional: In such persons "we have the emotionality which is the sine qua non of moral perception; we have the intensity and tendency to emphasis which are the essence of moral vigor" (James, 1902). In his mind, eminence was a combination of superior intellect with "ardor and excitability of character."

In formulating the concept of developmental potential, Dabrowski laid particular stress on intellectual, emotional and imagination OEs. He saw them as necessary to personal growth characterized by moral questioning, existential concerns and self-judgment. In this type of development the individual engages in the work of inner psychic transformation. The effort of will to overcome one's lower propensities and to follow one's ideals is deliberate and extends over most of a person's life. It does not mean, of course, that the effort is necessarily steady and the progress uniformly upward. What it does mean is that the person does not give up the search even though he or she falls, slips back, yields to discouragement and self-doubt, but takes it up again and again. This type of development, the more intense and sustained it is, produces highly moral individuals and spiritual leaders. *The Journal of a Soul* of Pope John XXIII, Dag Hammarskjold's *Markings*, Eleanor Roosevelt's *You Learn By Living*, document the unceasing labor at personal transformation. The aim of this transformation is to make one's ideals and actions one and the same, to live according to the precepts of love, compassion, helpfulness, and effective action.

In Dabrowski's vision development of personality was stratified into five ascending regions or levels (Dabrowski, 1967; Dabrowski & Piechowski, 1977). "Levels of personality development" is really a very abstract notion and I prefer to speak here of "regions" to convey something of their complexity and variety. Self-serving motivations, lack of perception of the other's emotions, possessiveness, superficial attachments, lack of perception of the other's emotions, guide the region of Level I. In the next region—Level II—there is either a sense of inner fragmentation ("I feel split into a thousand pieces") and resulting oscillations of mood, vacillations in action, switching between opposites, or a fairly integrated world view of unregenerate relativism and submission to mainstream values and conventions. Here the self derives its definitions from fulfilling the expectations that others, family or society, hold for one. Personal growth in this region is most often the struggle toward the emancipation of an individual sense of self.

The condition of entry to the next region, or Level III, is a sense of self which may be vulnerable and threatened yet deep down is autonomous. Here, at first a vague but gradually stronger and clearer experience of a vertical split within the self makes itself felt: the lower vs. the higher (in the sense of an inner ideal), "what ought to be" vs. "what is" (in the sense of a loathsome state of affairs of failing one's ideals, falling short of one's potential, perceiving oneself lacking in empathy, helpfulness, etc.) It is in this region that moral questions become important and may be intensely felt. It is here that others are always seen as individual persons and the principle of the greatest good for the greatest number is felt to be inadequate. The deepening understanding of universal ideals and their individual realization are themes that continue into Levels IV and V. (For those who wish to compare this theory against the yardstick of Kohlberg's theory, suffice it to say that Dabrowski deals with personality traits, types of personal growth, and motivation for moral action rather than with principles of moral reasoning and justice. Consequently, the reply to the question "why be moral" or "why be good" is to be found in the very emotional power with which moral questions are felt. Like James, Dabrowski stresses the importance of emotions as motivators and like Gilligan, he stresses the centrality of empathy and of a sense of personal responsibility. "Levels" in the two theories are not directly comparable. Tentatively, one might view Kohlberg's stages 1-4 as encompassed by Dabrowski's Level I, stage 5 by Level II, and stage 6 by Levels III and IV. The much discussed hypothetical stage 7 (Kohlberg, 1981) seems to correspond to Level V which Dabrowski elaborated in significant detail.)

Ascending into the next region—Level IV—we encounter fully grown self-actualizing people. It so happens that Maslow's composite picture of self-actualizing individuals fits exactly Dabrowski's construct of Level IV, a conception of the kind of people who have developed a strong sense of universal values and whose extraordinary sense of responsibility leads them to take up tasks for the sake of others (Piechowski, 1978). Maslow (1970) pointed out these people are strongly focused on problems outside themselves. They focus on problems rather than on the protection or enhancement of their ego. They perceive tasks to fulfill because they respond to the need or urgency of the times.

Eleanor Roosevelt's life is an example of self-actualization (Piechowski & Tyska, 1982). The extent and power of her compassion, and the deliberate effort to follow Christ as her inner ideal, reveal in her development characteristics that go even higher, technically speaking from Level IV to Level V. At present, however, theoretical categories help more to understand such an extraordinary life than to decide on the exact "level." From early childhood, Eleanor Roosevelt exerted her will to conquer tears, fatigue, her voice, physical awkwardness, numerous fears, ingrained social and racial prejudice, depressions, loss of life. In all this her life of prayer was hidden, but the work of inner psychic transformation was always there (Piechowski, 1984). A diary entry when she was 14 records her struggle to become a better person. She responds here to a verse with a call to duty and unquestioning acceptance of God's plan:

> It is very hard to do what the verse says, so hard I never succeed and I am always questioning because I cannot understand and never succeed in doing what I meant to do, never, never . . . I can feel it in me sometimes that I can do much more than I am doing and I mean to try till I succeed. (Lash, 1971, p. 112)

Just as William James described moral action as the effort of will in the line of greatest resistance, so did she attack points of emotional resistance in her struggle for self-mastery. This was the principal goal through the first half of her life; later it was the service to her country and the whole world (human rights and peace). She knew how difficult it was to attain self-knowledge, because only those who try find that out. She knew that to face the named truth about oneself requires real courage. Self-examination has to be frequent and one has to be on guard against "that protective veiling one hangs over the real motives" (Roosevelt, 1960). Having lost more than one of those she loved most—her father and her brother—and having lost the love of her husband, she feared the recurrence of such losses; yet every time she transcended that inner split through acceptance and through an expansion and deepening of her love. She was an adept in nonpossessive love. The words of her evening prayer give insight into the way she lived her life. The will to follow an inner ideal is clearly expressed:

> Our Father, who has set a restlessness in our hearts and made us all seekers after that which we can never fully find, forbid us to be satisfied with what we make of life. Draw us from base content and set our eyes on faroff goals. Keep us at tasks too hard for us that we may be driven to Thee for strength. Deliver us from fretfulness and self-pitying; make us sure of the good we cannot see and of the hidden good in the world . . .
>
> (Roosevelt & Brough, 1977)

Finally the highest region—Level V—epitomizes universal compassion, self-sacrifice, and total dedication to the service of others. Dag Hammarskjold is a good example. Rather than seek the personal happiness of marriage and family life, he chose to serve all nations, but especially the small, emerging nations of the world. It was not an easy choice, and he knew the pain of personal deprivation. Because he made the United Nations operate according to the ideals of its charter, he has been called the servant of peace. The inner transformation he forged in his life opened to him transcendental vistas:

> Now you know. When the worries over your work loosen their grip, then this experience of light, warmth, and power. From without—a sustaining element, like air to the glider, or water to the swimmer. An intellectual hesitation which demands proofs and logical demonstration prevents me from believing in this, too. Prevents me from expressing and interpreting this reality in intellectual terms. Yet, through me there flashes this vision of a magnetic field in the soul, created in a timeless present by unknown multitudes, living

> in holy obedience, whose worlds and actions are a timeless prayer.
> The Communion of Saints and within it an eternal life.
>
> (*Markings*, entry from year 1952)

How can we approach the search for signs of developmental potential that would predispose a person to that kind of far-reaching transformation? Such persons are destined to lead by the power of their ideals, because they live them. No doubt there are other Eleanors and Dags who could achieve comparable eminence but are not historically destined to do so. Still, they live among us.

## Empirical Studies of Developmental Potential in Adults

Lysy and Piechowski (1983) undertook an empirical study of the relation between the components of developmental potential, developmental level, and type of development—transforming vs. nontransforming. The study bore out James's original observation that the intellectual and emotional forces together make for eminence. Contrary to Dabrowski's original stipulation, imaginational OE contributed little to developmental level. Clearly, as shown in the study of artists (Piechowski, Silverman, & Falk, 1985) imaginational OE is essential to genuinely creative work. But unlike moral behavior, creativity is not limited by developmental potential.

The subjects in the Lysy and Piechowski study were rated in regard to whether or not they displayed the characteristics of transforming or nontransforming personal growth. Transforming growth is characterized by moral questioning, existential concerns and self-judgment against an autonomous hierarchy of values. There is a strong sense of self and a need for self-development to serve the human community more fully. Nontransforming growth lacks comparable developmental focus and thrust. Although there might be sensitivity, caring and motivation to work for the welfare of others in practical ways, the main goal is self-awareness and self-acceptance rather than a fundamental change in oneself.

The transforming quality strongly correlated with developmental level. Robert and Piechowski (1980) attempted to identify variables that could discriminate between these two types of growth. Robert (1984) found that the transforming subjects "felt a strong responsibility toward others and their own development which led them to risk going beyond the confines of their jobs or primary relationships to put this sense of service into action." The nontransforming subjects, while also expressing the desire to be of service, did not manifest such a sense of responsibility or an urgency to act on it.

Many people have ideals but few are committed to them. Personal transformation, however, must be empowered by an ideal. There is a sense of responsibility toward one's ideal; with it comes the urge to take up the work of transformation. Nontransforming subjects, while having ideals, seem to lack this urge; their expressed ideal might be self-acceptance. But the others are moved to self-correction and ever renewed efforts to make their ideals a living reality—first in themselves and then perhaps to inspire others in the same direction.

A nearly completed study by Brennan (1985) gives new insight into the developmental and individual differences among self-actualizing people. Brennan used the intensive case study approach. In order to elicit relevant material he deliberately defined for the subjects each of the many components of Levels III and IV just as Dabrowski stated them in his theory.

Twenty-one individuals were nominated as likely to be engaged in development toward self-actualization. Using an instrument for assessing developmental level (Gage, Morse, & Piechowski, 1981), three were found to be in this category. All three were gifted. The strenuous interview focusing on inner dynamisms presented no problem to these people; they responded readily for several hours without any indication of fatigue. Several dominant themes emerged. All three have chosen work directed to benefit humanity: nursing, education, research. All have a distinct philosophy of life that emphasizes such principles as being true to one's inner voice, fostering harmony, a sense of being part of the greater scheme of spiritual evolution, a sense of human community, a Zen principle of detached commitment. Attention to personal growth is clearly there although in one case it is more implicit than explicit. The sense of responsibility is very strong and very active. These three have a strong sense of self and each one went through a critical point at which they had either to choose and affirm their own self or to deny it.

The detailed information obtained in the guided interview was checked against the theoretical terms built into Levels III and IV. This furnished a profile showing how far the subject is on the road to self-actualization (i.e., Level IV). Two of the three subjects were found to be well advanced. Interestingly, the less advanced subject was also the youngest of the three (middle 30s).

## Studies of Developmental Potential in Adolescents

Studies of adults inform us about self-actualizing development retrospectively; they do not give us sufficient insight to recognize a child or adolescent who might have a distinct potential toward self-actualization but whose life is still ahead with all its risks, trials, and unpredictable turns.

Adolescents are generally found to be lacking in the capacity for the type of self-judgment that is the condition of inner growth (Buescher, 1985). They can be cuttingly critical of others and the world around them but at the same time incapable of directing their sharp judgments at themselves. A thoughtful teenager capable of sensitive self-perception and self-evaluation may be rare but such a youth might have a strong potential for self-actualizing growth. Piechowski et. al. (1983) examined the content of the OEQs obtained from a small sample of gifted adolescents in a two-year pilot study. At the time of the follow-up they varied in age from 14 to 18. In terms of individual development they were engaged in meeting the demands of school and career; some of them lack evidence of growth issues, while others showed varying degrees of emotional awareness. A number of them showed evidence of particularly intense emotional growth which had several of the following characteristics.

1. Awareness of growing and changing, awareness of different possibilities of developmental paths open to them. These youngsters think of different directions that they can take in life; they give the impression of running mental experiments on the possibilities ahead of them and the different outcomes to which their choices might lead. They are aware of psychological changes in themselves.
2. Awareness of feelings and conscious attention to them, interest in others as persons and empathy toward them. They show distinct interest in their own emotions and those of others. Their interest in others as persons extends to all ages.
3. Feelings of unreality are present occasionally, marking periods of particularly intense emotional growth. At times they find themselves in a daze or as if in a dream, feeling quite apart from even the closest family. But this endows them with new perspectives; they travel far in inner spaces gaining new outlooks on others and on themselves.
4. Inner dialogue and self-judgment, at times quite severe. These youngsters monitor themselves closely. Their conscience is sensitive and fitted with a spur to self-correction—the opposite of the average adolescent lacking in self-judgment.
5. Searching or problem-finding, asking questions which are basic, philosophical, existential. Self-scrutiny, questioning, and the search for truth go together. Somehow these youngsters are already interested not only in objective truth but in inner truth as well.
6. Awareness of one's real self and that it is hidden from others. They realize that their self-knowledge is quite different from the way others know them.

These characteristics are not related to age because they were noted in some of the 12- and 14-year-olds. Rather, some gifted adolescents become aware of their emotional life and their inner self as early as 12, perhaps even earlier, and this awareness becomes richer and deeper in subsequent years. The combination of a searching intellect with intense emotionality gives them the potential for eminence (James's "effective genius") although its realization is a function of historical and cultural circumstance (Feldman, 1982). Gifted adolescents with lesser developmental potential appear to be drawn primarily to well paved obstacle courses governed by established norms of achievement, recognition, and responsible citizenship. These seem to fit the rational-altruistic type of character development as described by Peck and Havighurst (1960).

It might be worth noting that Sommers (1981) found strong positive relationship between an extended emotional range and cognitive complexity. She suggested that the more developed and more sophisticated a person's system of values, the better focus there is for critical evaluation of one's own and others' conduct. This echoes the basis for reliable moral outlook that Maslow found in self-actualizing people—"they do right and they do not do wrong"—regardless of social conventions. The question of the primacy of cognition or emotion continues to be debated (Zajonc, 1981, 1984; Lazarus, 1984). No doubt there are several possible patterns. One of Brennan's subjects achieved such a degree of harmonious integration between his emotions and his intellect that on the OEQ he gave primarily responses indicative of intellectual OE. But another self-actualizing subject was guided chiefly by the power of her intuition and empathy. She does not lack intellectual OE, but it takes second place to her sensitive tuning into the emotional conditioning of another person. Whether strongly intellectual or strongly emotional, what self-actualizing people do have in common is a humanistic orientation, an investment in the world of people, their lives, their aspirations, and their fates.

## Summary

If we were to look for moral giftedness and potential for self-actualization, we must look for it in the personal domains. A superior intellect without Maslow's Gemeinschaftsgefuhl (a feeling of fellowship with others) to go with it strikes us as inhuman. By introducing the concept of personal intelligences, Gardner (1983) provided constructs which are helpful in ordering our quest. What the model of developmental potential contributes is the definition of personal attributes by which a "personal" intelligence may rise above the average to the level of true talent. The greater the strength of intellectual and emotional OEs in concert with the transforming quality, the stronger is the potential for self-actualization and outstanding moral development.

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# Comparison of Intellectually and Artistically Gifted on Five Dimensions of Mental Functioning*

*Michael M. Piechowksi, Northland College, Ashland, Wisc.; Linda K. Silverman, The Gifted Child Development Center and the Institute for Study of Advanced Development, Denver, Colo.; and R. Frank Falk, University of Denver*

Summary.—Two talented groups (artists and intellectually gifted) and one comparison group (graduate students from various disciplines) were examined on five dimensions of mental functioning: psychomotor, sensual, intellectual, imaginational, and emotional. These dimensions constitute a model of developmental potential representing, respectively, the personal level of energy, sensual aliveness, pursuit of knowledge and truth, imagination, and life of feeling. According to this model, the strength, richness, and depth of talent are a function of the strength of these five dimensions, measured on an open-ended questionnaire. Analysis showed that intellectual talent tends to be associated with high scores on three dimensions (especially strong on imaginational and emotional). In contrast, the graduate students had lower scores on all five dimensions.

There are important characteristics of talented people which current approaches to the study of talent (Bloom, 1982; Stanley, 1976) have ignored. A number of authors have noted in talented people their heightened intensity of experience. Goertzel, Goertzel, and Goertzel (1978, p. 338) observed that the eminent as children and as adults "continue to react strongly to stimuli—sexual, esthetic, emotional, intellectual." Roe (1975) found that for many painters "visual stimulation, reaction to things seen is intense, sometimes almost painfully so." Bachtold (1980) quoted several writers: "I feel too much, sense too much, am exhausted by the reverberations" (May Sarton); "Language is a clumsy medium to express the pounding surge of intense feeling . . . Music could drive my blood and suffuse my entire being" (Malvina Hoffman.) From his study of English men of science, Galton (1872) concluded that "in a man of genius, the ideas come as by inspiration; in other words, his character is enthusiastic, his mental associations are rapid, numerous and firm, his imagination is vivid, and he is driven rather than drives himself." (p.233).

To study these characteristics we employed a model of developmental potential positing five broadly defined areas of psychic life each with many possible expressions and manifestations: psychomotor (P)—movement, restlessness, drivenness, a capacity for being alive and energetic; sensual (S)—enhanced differentiation and aliveness of sensual experience; intellectual (T)—avidity for knowledge, discovery, questioning, love of ideas and

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theoretical analysis, search for truth; imagination (M)—vividness of imagery, richness of association, facility for dreams, fantasies and inventions, animisms and personifications, liking for the unusual; and emotional (E)—great depth and intensity of emotional life expressed in a wide range of feelings, compassion, attachments, heightened sense of responsibility, self-examination (Piechowski, 1979). Without some degree of intensity in these five areas in the individual, talent is mere technical facility, a computational machinery without conception or heart.

These five dimensions may be thought of as channels of information flow and as modes of experiencing. They can be wide open, narrow, or barely present. They were originally called "forms of psychic overexcitability" (Dabrowski, 1937) and the term is still used. The term overexcitability denotes enhanced and intensified mental activity distinguished by characteristic forms of expression which are above common and average. As enhanced forms of experiencing, they contribute to the individual's psychological development, and so the strength of overexcitabilities is taken as a measure of developmental potential (Dabrowski & Piechowski, 1977; Piechowski, 1979). To some, "overexcitability" suggests something dysfunctional, but the term is a translation of the Polish word "*nadpobudliwosc*" meaning "superstimulatability"; the intended sense is of robust surplus and intensity.

Our study compares overexcitability profiles of three groups: (1) adults active in art, music, literature, and other artistic fields, (2) intellectually gifted adults, and (3) university graduate students in a variety of fields. One of our objectives was to test the usefulness of the Overexcitability Questionnaire for the study of different forms of talent. We expected the three groups to have quite different overexcitability profiles.

## Method

The five forms of overexcitability were assessed by means of the Overexcitability Questionnaire (OEQ), a 21-item, free-response instrument (Lysy & Piechowski, 1983). Subjects wrote their responses at their leisure. Responses on each of the 21 items were rated on a scale of intensity from 0 to 3. Zero indicates no overexcitability, 1 indicates weakly expressed overexcitability, 2 indicates a distinctly recognizable expression, and 3 indicates a rich and intense expression. The range of possible scores on each dimension is 0 to 63. In this study the highest assigned score was 43, on emotional, the lowest was 0. Examples of responses are reported by Piechowski and Colangelo (1984).

Each protocol was scored independently by two raters. Disagreements on item scores were resolved by consensus. Items resisting consensus were submitted to a third, more experienced rater for arbitration. The Pearson interrater correlation coefficients across all five dimensions and with different pairs of raters ranged from .60 to .95, the most common being .70 to .80. The average correlation for all 10 raters in this study was .75. These values of r were obtained prior to consensus. The correlation between the individual rater's score and the final consensus was .82.

The subjects were adults identified as intellectually gifted by membership in Mensa (98th percentile rank or better on some standard test of intelligence) or persons similarly qualified in gifted classes, or recognized scholarly achievement (n = 37, 11 men and 26 women, 22 to 55 years old, mean age 35.6 years). Neither intellectual heterogeneity nor the wide spread in age are significant factors in our study. The presumably more defined Mensa subgroup (n = 13) had virtually the same distribution of overexcitability scores and the same mean scores as the whole sample, and the whole sample, which is adult, had the same mean overexcitability scores as a sample of gifted adolescents (Piechowski & Colangelo, 1984). The artists included writers, poets, musicians, fine artists, film producers, and dancers-choreographers (n = 23, 11 men and 12 women, 18 to 59 years old, mean age 36.2 years). This diversity is also not a factor for this study. Eiduson (1958) showed that artists share common cognitive, emotional and motivational characteristics that set them apart from nonartists. The graduate students were taken from the study by Lysy and Piechowski (1983); they included students in counseling, history, linguistics, natural sciences, education, library science, political science, and religious studies (N = 42, 30 women, 12 men, 22 to 50 years old, mean age 29 years).

## Results and Discussion

Statistical computations were carried out using BMDP (Bio-medical Package) 2v computer program for analysis of variance and analysis of covariance (including repeated measures). Equal Ns and unequal Ns analyses of variance and two-way analysis with repeated measures yielded virtually identical results. For the equal-N comparison, subjects from the larger samples were selected at random. For ease of interpretation we shall discuss the results from the standard two-way analysis. There were overall significant differences between groups on forms of overexcitability (Table 1). The finding of a significant group by overexcitability interaction was further analyzed with the Scheffe procedure for pairwise comparisons (Table 2). Because the Scheffe procedure is conservative, the Type I probability requirement was relaxed to compensate for its decreased power. The conservative nature of the Scheffe produced with unequal Ns suggests that

TABLE 1
SUMMARY OF ANALYSIS OF VARIANCE WITH UNEQUAL Ns

| Source | df | MS | F | p |
|---|---|---|---|---|
| Two-way Analysis of Variance | | | | |
| Overexcitability | 4 | 1329.70 | 35.37 | .01 |
| Group | 2 | 1837.32 | 48.88 | .01 |
| Overexcitabilty × Group | 8 | 141.71 | 3.77 | .01 |
| Residual | 500 | 37.59 | | |
| Two-way Analysis with Repeated Measures | | | | |
| Group | 2 | 1837.32 | 19.86 | .01 |
| Residual | 100 | 92.53 | | |
| Overexcitability | 4 | 1329.70 | 55.74 | .01 |
| Overexcitability × Group | 8 | 141.71 | 5.94 | .01 |
| Residual | 400 | 23.85 | | |

### TABLE 2
### MEANS AND STANDARD DEVIATIONS OF MEASURES BY GROUPS

| Over-excitability | Artists n = 23 | | Intellectually Gifted n = 37 | | Graduate Students n = 42 | |
|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD |
| Psychomotor | 7.79 | 3.87 | 5.92 | 3.71 | 3.97 | 2.50 |
| Sensual | 8.08 | 4.58 | 6.14 | 5.08 | 4.52 | 4.08 |
| Intellectual | 11.21 | 5.52 | 12.19 | 6.84 | 6.78 | 5.01 |
| Imaginational | 17.25 | 8.93 | 10.94 | 7.66 | 6.28 | 5.28 |
| Emotional | 20.54 | 10.38 | 14.11 | 8.94 | 9.42 | 6.53 |

probabilities .20 be considered significant (Hays, 1963, pp. 487-489). Of the 15 pairwise comparisons between groups, 10 were significantly different.

The mean overexcitability scores for each of the three groups are given in Table 2 and Figure 1. Overall, the artists are significantly higher than the graduate students on all give forms of overexcitability (psychomotor, p .20, sensual, p .20, intellectual, p .05, imaginational, p .01, emotional p .01, and they also have significantly higher emotional and imaginational scores (p .01) than the gifted. The gifted have significantly higher scores on emotional (p .01), and imaginational and intellectual overexcitabilities (p .05) than the graduate students. There is a general monotonic trend among the overexcitabilities with the emotional highest and followed in order by imaginational, intellectual, sensual and psychomotor. Specific results for each group on each index of overexcitability are discussed below by group and related to similar findings by other authors.

## Artists

The presence of high emotional overexcitability in artists, significantly higher than in the other two groups, agrees with Drevdahl and Cattell's (1958) finding of a high index of sensitive emotionality in artists. The depth, intensity of feeling, and emotional sensitivity, especially in introverted individuals, can set them apart, hence the finding that artists often appear to be socially aloof (Barron, 1963; Getzels & Csikszentmihalyi, 1976). Barron (1952) observed that artists and creative persons in general have a greater range and depth of feeling ("unrepressed intense sensibility"); beautiful or sad things can move them to tears. In Patrick's (1935, 1937) studies, 80% of her 100 painters and poets reported that they created in a "warm stirred-up emotional state." But Gotz and Gotz (1979) reported findings that seem to contradict this. They have shown that successful artists have a higher mean psychoticism score, and indication of their being solitary, lacking in feeling, lacking in empathy, being hostile to others, etc. However, the psychoticism index is not an appropriate measure of emotionality. Bachtold (1980) pointed out that the higher psychoticism score of successful artists is really an index of their aggressiveness and drive, not evidence of harsh or cold emotionality. A minority of artists might be like that—in Patrick's study about 20%. Two things have to be kept in mind: one, there are important individual differences, and two, the use of productivity and success as measures of talent is inappropriate and misleading because neither bears a direct relationship to the nature of talent.

The concept of emotional overexcitability is intended to capture individuals' experience of their emotional life. Artists occupy a special position in regard to this. They experience life most intensely and have the capacity to express their image of life and "thus (to) invite others to test the reality of their perceptions and, in a sense, to join them" (Barron, 1963, p.235). Susanne Langer views artists as experts in the knowledge of subjectivity. Subjectivity as the life of feeling encompasses "the whole realm of awareness and thought, the sense of absurdity, the sense of justice, the perception of meaning, as well as emotion and sensation" (Langer, 1967, p. 55). According to Langer, art serves to make sense of our experience by giving us the form of the experience (Piechowski, 1981). This is what makes art significant.

Langer's theoretical perspective provides the logic for the artists' high imaginational and intellectual scores. Only highly developed imagination can transpose lived experience into significant images and highly developed intellect enables the artist to solve the technical problem of how the transposition is to be done.

The concept of imaginational overexcitability stands for the spontaneous activity of a mind that freely makes unexpected associations, reaches into invented realms, takes any form as a stimulus to perceive other forms, including nonvisual ones. Drevdahl and Cattell (1958) and Getzels and Csikszentmihalyi (1976) found artists to be very high on autia ("imaginative, careless of practical matters, unconventional, absentminded"), one of the 16 source traits in Cattell's personality inventory. A person high on autia is characterized by an intense subjectivity and inner mental life, and by an "internally autonomous" thinking with impracticality and hysterical mood swings thrown in for good measure (Cattell, Eber, & Tatsuoka, 1982, p. 82). Clearly, the autia construct includes, besides imagination, also feelings, moods and intellectual inclinations.

The construct of imaginational overexcitability is aimed at imagination alone as "the force of invention" (Gerard, 1774). As a free-response instrument the Overexcitability Questionnaire can, through content analysis, give insight into the workings of a person's imagination; it has the advantage of providing both quantitative and qualitative data.

The artists' mean score on intellectual overexcitability is virtually equal to that of the intellectually gifted. Intellectual overexcitability must not be equated with intelligence. Intellectual overexcitability encompasses curiosity, inquiringness, thirst for knowledge and truth; it represents a theoretical, probing, reflective stance. The Allport-Vernon-Lindzey Study of Values similarly defines a "theoretical value" as an interest in and pursuit of truth, a desire to gain knowledge, systematize it, and bring order to it.

MacKinnon (1960) and Getzels and Csikszentmihalyi (1976) described artists' and architects' "inquiringness"—their unending curiosity about things, people and nature—and their strong preference on the Study of Values for the theoretical value. The artists score low on economic value, an expression of their disregard for material values. Hazell (1984) found a high correlation of intellectual overexcitability with the theoretical value and a high negative correlation with the economic value. Roe (1946), Eiduson (1958), Getzels and Csikszentmihalyi (1976), and Rothenberg (1979) also found in artists a strong tendency toward abstract and theoretical thinking.

The artists' high score on sensual overexcitability is also corroborated by previous research. Creative persons prefer the experiential, primitive and sensual (Barron, 1952, 1963). Lowenfeld (1962), Getzels and Csikszentmihalyi (1975, 1976), and Piechowski and Cunningham (1986) observed artists' unusual sensitivity to what they see, hear, and touch, and their ready response to the "feel" and texture of qualities of materials.

The artists also have a higher mean psychomotor score which suggests a higher energy level than the other two groups. This parallels Barron's (1963) and Roe's (1946) findings that artists are vigorous people capable of unusual energy output and perseverance.

## Intellectually Gifted

Intellectual giftedness is often manifested in avidity for learning, curiosity, inquisitiveness, problem solving and the like. Because these characteristics partly overlap with expression of intellectual overexcitability we expected to find in our sample of intellectually gifted adults a dominant peak on this dimension. Surprisingly, however, emotional, imaginational, and intellectual scores of our sample are more or less equal. If scientists are taken as exemplars of intellectual giftedness, then we should find also in them evidence of emotional overexcitability.

The scientist is often presented as impersonal and dispassionate. Most of the highly creative chemists and mathematicians studied by Clifford (1958) were cold, objective and highly competitive. Some denied the importance of emotion in achieving significant accomplishments in science. But Mitroff (1974) in interviews with Apollo scientists found these statements to be typical: "The idea of the dispassionate, disinterested observer just isn't so. The more you work on a subject the deeper the commitment becomes;" "No one is able to do anything with liberal energy if there is no emotion connected with it" (p. 65). Mitroff concluded that these highly competitive scientists displayed only that part of emotionality that contains the aggressive and harsh emotions. Yet there are scientists, such as Pasteur, Edison, or Norbert Wiener, who show the tender emotions as well. In Clifford's study a few exceptions were just like these. Again, we are dealing with a wide range of individual differences. It is worth remembering that intellectual talent is not limited to science alone and that our intellectually gifted group was highly heterogeneous. Their emotional scores ranged from 2 to 36 with a median of 11, as compared with the artists' range from 6 to 43 with a median of 22, and graduate students' range from 0 to 22 with a median of 7.5.

Leta Hollingworth (1942) observed particularly enhanced emotional and moral sensitivity in the highly gifted. Silverman (1982) found evidence of emotional sensitivity and intensity of feeling in parental reports of nearly every young gifted child she tested. Colangelo (1982) found that the majority of gifted adolescents think about moral issues in terms of interpersonal relationships and responsibilities, which is to say, in emotional rather than abstract intellectual terms of rights and justice. All this underscores the importance of emotional endowment in the makeup of intellectually gifted persons. We may wonder, however, what emotional changes less gifted people undergo in the competitive regime of graduate study and professional work.

## Graduate Students

The intellectually gifted and the graduate students are both intellectual groups. Their mean overexcitability scores are parallel.

The low excitability profile of the graduate students is not unexpected. Wing and Wallach (1972) showed that college admissions to prestigious institutions rely primarily on test scores and high school class rank, not on evidence of talent. Yet real-life postgraduate achievement is not correlated with test scores and grade averages but with nonacademic accomplishments, e.g., distinction in writing, art, drama, music, social service. Barron (1963) found that departments in the sciences and the professions rated highest on personal soundness students who were adaptable, calm, moderate, realistic, and serious, and rated lowest those who were perceived as immature, tense, emotional, peculiar, etc. Departmental raters were selecting the pattern of high stability combined with low responsiveness, in other words, no marked overexcitability. The selection is for solid work and against imagination. Historians of science have come to similar conclusions (Brush, 1974). When the departments rated their graduate students on originality, the favored profile was of "the more scholarly type in a single field of endeavor, efficiently self-disciplined, and socially somewhat inflexible and withdrawn" (MacKinnon, 1975, p. 65). The selective process for graduate studies appears to favor candidates with an attenuated overexcitability profile. In fairness, however, we must mention that 14 out of the 42 graduate students in our sample, ie., one third, showed an overexcitability profile identical to that of the intellectually gifted (Piechowski & Colangelo, 1984). One would expect this proportion to vary depending on the selection criteria of the institution.

## Conclusion

The model of developmental potential integrates five dimensions of mental functioning: the life of feeling (E), imagination (M), the pursuit of knowledge and truth (T), level of personal energy (P), and sensual aliveness (S). The model is particularly well suited to the study of individual differences. The picture that emerges is this: artistic talent tends to be associated with high levels of all five overexcitabilities, most markedly imaginational and emotional, while intellectual talent tends to be associated with a high level of intellectual, imaginational, and emotional overexcitabilities. Our results for these groups show good agreement with previous research as well as with Susanne Langer's (1967) view of the artist as one who has the skills to discover, capture, and express the varied forms of human experience.

The model of developmental potential treats imagination as a human capacity distinct from emotion and cognition. The boldness of one's imagination is a major contributor to the originality of talent. A recent inventory, the Wilson-Barber Inventory of Childhood Memories and Imaginings (Myers, 1983), appears to tap most of the characteristics of imaginational overexcitability which we find in the content analysis of responses to the Overexcitability Questionnaire.

Assessment of creativity has not always taken imagination sufficiently into account. Although Dearborn (1988) devised a simple yet highly effective quantitative method of tapping imaginative responses, he nevertheless concluded that "the qualitative side better suggests the mysteries of association and imagination." The Overexcitability Questionnaire has the advantage of providing both quantitative and qualitative data in regard to all five dimensions.

The model of developmental potential also contributes to our understanding of individual differences in talented people. For each group of subjects there is a wide range of scores on each form of overexcitability. Added to this is the varied individual content of responses. One may well ask which way lie the more interesting differences: between different kinds of art or scholarly disciplines such as poetry vs. music or biology vs. physics, or between individuals within a given domain. Piechowski and Cunningham (1986) found three different overexcitability patterns among artists: Pattern A with strong, balanced overexcitabilities, Pattern B with emotional overexcitability and sensitivity so dominant that it colored all other forms of overexcitability, and Pattern C with lower emotional overexcitability but the remaining ones unharmonized, strident, restless and driven.

The nature of talent, its particular tone and direction of development must be seen as an interplay of imagination, intellectual acumen, and richness of feeling. The model of developmental potential enables us also to look into the interaction of the intellectual and emotional dimensions for the source of unrelenting self-evaluation and striving for perfection which are the mark of a truly compelling talent.

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# Inner Conflict as A Path to Higher Development in Women*

*by Linda Kreger Silverman, The Gifted Child Development Center and the Institute for Study of Advanced Development, Denver, Colo., and Elizabeth Schuppin, University of Denver*

A sometimes forgotten means of crisis is "a turning point." Rather than hardship thrust upon us, mid-life crisis may be an invitation to higher development and an indication that growth, begun deep within, is happening. This is the theme of today's presentation.

Mid-life crisis feels like the disintegration of self, a loss of self-definition. The experience can often be terrifying, for the individual believes that when that self is stripped away, there may be nothing left. "Under all my facades, I am a non-person." What causes it all to come apart?

There is loss. A husband dies or exits through divorce. Parents die. A rebellious child takes to the road. Youth fades in a culture that cherishes youth. Being needed, the role of the selfless nurturer, diminishes and children become independent or husbands become absorbed in their careers.

And there is stress. Along with experiencing loss, women may be juggling jobs and housecare, coping with adolescent offspring, dealing with ailing parents, and, possibly, watching a husband anguishing through his own mid-life crisis.

But there is often another, more mystifying component—that inner, undefinable queasiness, that feeling of despair for no good reason, of wrongness which one cannot put one's finger on. Having done all the right things and done them well, there now wells up a terrible, gnawing sense of unease and bewilderment. Women ask, "What have I done wrong? Why do I feel this way?" Depression clouds over everything. All of the people and activities which once gave life meaning have lost their power. There is a profound feeling of emptiness which nothing seems to fill.

In the past, women with such feelings were often advised to ease the situation by taking up something new: a hobby, volunteer work, a cause—something to "take your mind off yourself." They were seen as temporarily disoriented by a lack of purpose, as brooding neurotics needing to be returned to normalcy. It was as if their feelings had no validity.

Dabrowski's Theory of Emotional Development speaks to these feelings in a new way. The theory describes a transformative process, a pathway to higher level development, which requires the disintegration of the current psychological structure in order to evolve into a more integrated, complete level of development. It is different from other stage theories, in that it proposes that the higher level structure and the lower level structure exist side by side: the higher one does not grow out of the lower one. This creates inner conflict between two different conceptions of reality. As the higher level structure expands, the lower level structure diminishes, but not without a fight for its survival.

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The theory was conceived by Polish psychiatrist and psychologist Kazimierz Dabrowski in 1938. Dabrowski witnessed acts of complete self-sacrifice in the midst of incomprehensible inhumanity during two world wars, and he could not understand how both could exist in the same world. Were the humane and the inhuman all made of the same cloth? He thought not. His theory is an outgrowth of his own confrontations with death, suffering and injustice, and his insatiable desire to understand the meaning of human existence.

Dabrowski's Theory was translated, refined and put to empirical test by Michael Piechowski, a scientist and psychologist at Northwestern University. It has recently begun to receive attention in this country.

The theory posits five levels of development, each of which represents a distinct psychological structure and creates a unique world view. At Level I, there is little genuine concern for others. The individual is completely egocentric, using others to meet his own needs. There is no self-reflection, no guilt, no emotional sensitivity. There is no inner conflict; all conflict is external in nature—obstacles between the person and his desires. Since there is no inner life to come between such persons and their ambitions, they often obtain power by ruthless means. At worst, the Level I personality is psychopathic, with no indications of growth potential. At best, the personality is shallow, emotionally closed to the needs of others—not from malevolence, but rather from deprivations of their own emotional needs.

Level II individuals are under the influence of the social group. Their main question, under all circumstances, is "What will others think of me?" The essential ingredient of development, an inner hierarchy of values, is lacking in such people. Since they have no means of directing their behavior from the inside out, they rely on others to tell them what to do. They feel powerless, uncertain about everything, and inferior to others. There is so much inner confusion that these people rarely know what is intrinsically right in a given situation. They conform to group standards out of a need for security, rather than out of a true commitment to those standards.

Most individuals in society are at Level II. They have ambivalent feelings and inconsistent behavior, reflecting their confused inner life. Piechowski calls Level II's "conservers," since their emotional and intellectual energy serve to maintain their current level of functioning. In contrast, the "transformers" of Level III use their energies in the service of higher level development.

There are many important distinctions between conservers and transformers that have relevance to women in mid-life. Conservers are extremely insecure and in constant need of validation from their world. So much of their energy is consumed by their need for self-esteem that there is little left for development or rich relationships with others. They may be warm, sensitive, easily moved, motivated to work for the welfare of others, and extremely concerned with close personal relationships. They are often quite empathic, and their empathy takes the form of overidentification with others, losing themselves in the drama of others' lives. Empathy may quickly turn to disdain if they don't feel appreciated for their caring. Their emotionality may take the form of dependence on others, jealousy, or self-deprecation. They experience a great deal of guilt about possibly not living up to others' expectations, and they are also quite capable of using guilt to manipulate others. The classical picture of "selfless" mother who peppers the soup well with guilt is a picture of the Level II personality.

Although by society's standards, Level II is considered "normal," there are striking clinical implications in this population. Level II's are more prone to psychosomatic disorders, alcoholism, drug addiction, phobias, and even schizophrenia. Their emotionality may not be well directed, but the very fact that it exists at all makes Level II developmentally advanced from the callousness of Level I. Their confusion is their first step in the disintegrative process of higher development. Many people stay in this confused state for their entire lives, clinging to their weak sense of self, and protecting themselves from further disintegration. But some move forward, risking everything they believe themselves to be to find a higher truth; these few are the transformers.

The critical element of the Level III personality structure is the awareness of an ideal in themselves toward which they must strive. They have a sense of "what ought to be" in themselves and they are dissatisfied with "what is." From this awakening there stems the beginning of an inner-directedness, a sense of personal autonomy, and an inner hierarchy of values. The vision of this ideal self has a transforming effect. There is no longer any contentment with oneself, with one's friends, with one's values, or with one's life. There is the knowledge that life holds something more and this fuels the processes of inner development.

Many of those who do make the transition to a higher form of existence do not consciously choose this path. Rather, they are "thrown into their destinies" by circumstances which seem beyond their control. The disintegrative process happens to them spontaneously, either through external events, such as the loss of a loved one, divorce, loss of employment, or a brush with death—all of which require a reevaluation of self—or through an internal, unconscious developmental process which does not appear to have an external cause. Suddenly, or gradually, everything that the person is, everything that gave her life meaning, seems meaningless. She is dimly aware that there is something missing, and she doesn't quite know what it is.

Whether the choice is conscious or unconscious, individuals at this level are most in need of, and most ready for, therapy. They are dissatisfied with what is and ready to take the next step in their development. They are very different from the clients who want to be patched up so that they can adjust more efficiently to their worlds, or the ones who want to complain how terrible the world is, but who seem to have little motivation to change themselves. This is a true turning point in their lives, and the struggle they are engaged in is extremely painful. They must let go of their need for approval, let go of their insecurities, believe in themselves, trust their own judgments, risk being different, and even face hurting everyone who depended on them to remain the people they were. Some can make this full transition into autonomy, and some cannot. But to begin this journey into self takes great courage.

My clients have often referred to this period of their lives as "the pit."

Others call it "the desert." There is a desire to become something other than what one is, but all one can see is blackness, nothingness. The person feels like she is dissolving. Depression, despair, despondency accompany this lonely journey. At times it seems as if no one can help. The individual leaves everything behind to seek an uncertain future. Enormous feelings well up and become confronted: feelings of guilt and shame at what one isn't, astonishment with oneself, anger at the injustice in the world and the suffering and the lack of values in others, feelings of inferiority toward one's own ideals. All of these emotional reactions serve to further development: they are the inner tools of growth. Inner conflict rages between the less developed, approval-seeking structure, and the more developed, autonomous structure.

In traditional therapy situations, the person would often be counseled to eradicate these neurotic symptoms. Disintegration was not valued as an important developmental step. In a developmental approach, the individual is applauded for the same symptoms and given encouragement to continue on the journey. The therapist serves to support the presence of inner conflict, rather than attempting to cure the symptoms or solve the problems. The therapist acts as a guide, holding a light at the end of the tunnel. Naturally, those therapists who have had the courage to enter their own pits and have emerged on the other side are in a better position to aid a counselee in this process. They have been there, and they have an intuitive sense of what is needed, when to sit quietly, when to step in, and when to be on call when the crisis hits its peak.

There is light on the other side. Transforming individuals develop a sense of self unlike anything they have previously experienced. They are no longer ruled by their worlds. They create their own lives. Their self-esteem goes from negative to positive. Their relationships with others become emotionally richer, more meaningful, more satisfying, more equal. They are not using relationships as a means of proving themselves to themselves. Because they are meeting their own esteem needs, they have more energy left to see the other person as a unique individual. Their ability to love increases for they are not manipulating others' emotions to serve themselves; they truly care about others.

A paradox occurs in the area of empathy which is difficult for the woman to understand. If she has identified herself as a selfless "helper," a nurturer of others, she will fear her own development, because she will sense that it is taking her away from the people she loves. She will fear becoming "selfish" by concentrating her energies on her own development. And she will fear her own detachment. In my own therapy, I remember my therapist repeating over and over, "You will be able to do everything you do now, just your attitude about it will be different." She was right, of course, but it took years before I understood what she meant.

The empathy at Level II—an overattachment to others, a living through others, a need to be needed as an identification of self—gives way to an empathy with a different form. The higher level empathy involves a degree of detachment. The Level III individual has faced her own suffering, understands its meaning to a greater degree, and is able to give comfort to others in their pain, rather than just wanting the pain to go away for her own comfort. Although she may appear to herself and to others to be undergoing a move away from caring about others, she is actually going through a process which will bring her into deeper, richer contact with her loved ones than she has ever envisioned.

Another byproduct of the transformation is the development of one's creativity. Level III individuals tend to be highly creative and to use their creativity to further their own growth. They become contributors to society, eloquently furthering the cause of justice in their writing, art, dance, drama and interactions with others.

Beyond Level III, there are two higher stages of development. Both of these stages are rare, but they have been attained by various members of our society, and so they remain possibilities. Level IV is the stage of self-actualization. The individual is autonomous, responsible, and in control of her life. All of the characteristics which Maslow (1970) has identified in self-actualizers apply to this group:

1. Clear, more efficient perception of reality
2. Acceptance of others, self, nature
3. Spontaneity; simplicity; naturalness
4. Problem centeredness rather than ego centeredness
5. The quality of detachment; the need for privacy
6. Autonomy; independence of culture and environment
7. Mystical and peak experiences
8. Deep sense of identification, sympathy and affection for humanity
9. Deeper and more profound interpersonal relations
10. Democratic character structure
11. Discrimination between means and ends, between good and evil
12. Philosophical, unhostile sense of humor
13. Creativeness
14. Resistance to enculturation; transcendence of any particular culture (Maslow, 1970, pp 153-172).

The person is able to actualize those higher values that she became aware of in Level III. She can commit herself to service, but not at the expense of herself. Her own growth is dependent upon her compassion for others. Concern for self and concern for others are no longer polarized; they are synchronized. As Maslow (1965) says, they are "synergistic."

The shame and guilt of Level III is replaced by self-acceptance, and the "striving" for higher level development is replaced by the certainty that the development is occurring. Inner conflict, fear of failure and resistance all melt away as this inner security is gained. The Level IV person does not have to force change; she just allows the evolution to happen naturally.

This acceptance filters into perceptions of others as well. The Level IV person genuinely appreciates others, loving their limitations as well as their strengths. She has great compassion for the pain of others, which motivates her to devote her life to service. Her compassionate detachment allows her to face a great deal of suffering and aid others without becoming lost in their suffering. It is a condition much to be wished in therapists.

Beyond self-actualization, there is even a more advanced level of existence, one that has only been reached by a cherished few. Dabrowski calls it "Secondary Integration," and it is the attainment of the personality ideal.

For most of us, it remains a vision of perfection, rather than a potentiality in this lifetime. One transcends the ego at Level V, and becomes in harmonious unity with the universe. A universal consciousness replaces an individual consciousness. There is no split between "what is" and "what ought to be"; the individual is a living manifestation of "what ought to be." Among the individuals who have attained Level V are counted Dag Hammarskjold and Mother Teresa of Calcutta.

Although the full attainment of Secondary Integration occurs only rarely, it is significant that Dabrowski's Theory includes it as a developmental possibility. The theory gives psychological credibility to the highest of human experience. The acknowledgement of an ideal is the first step in its actualization. As we understand more about the psychological factors involved in higher development, we may be able to nurture that development, and evolve to a race of compassionate beings.

It is important that the therapist recognize the difference between a set of societally imposed "shoulds" and an inner vision of a personality ideal in assessing a client's level of development. "Shoulds" are a Level II phenomenon; self-chosen ideals are Level III phenomena. They are quite different.

Another important factor in this theory is that development from Level I to Level V is impossible. A person may stay within a single level for an entire lifetime, growing within that level, but not undergoing the agonizing transformation to a higher level. Quite often a person will function on two levels simultaneously, and, at most, three levels, but the structure of one level will always be dominant.

Against the background of this theory, the positive value of supposedly neurotic traits which may surface during midlife crisis can be seen. The dark underside of the crisis, those often surprising feelings of "wrongness," of guilt for no reason, of nagging depression and senseless despair take on new meaning. They can be signs of growth, growth away from adapting to societal norms toward the beginnings of interiorized, self-grown values and gropings toward autonomy.

What is the role of the therapist then, in this situation? First of all, simply viewing the conflict and anxiety as positive signs of growth and health has in itself an ameliorating effect. The long overview becomes hopeful even though the immediate process remains painful. The therapist can support the woman during the transformation process, helping to reframe the elements of the situation in a positive light. The thrust of Dabrowski's Theory of Emotional Development might suggest validating these genuine feelings, allowing the disintegrative process but noting indications of new growth in such areas as owning one's experiences, examining one's values, asserting one's rights and beliefs. Emerging sensitiveness and reflectiveness are to be celebrated. Knowing that the ordeal is a necessary part of growth toward a higher integration can help both the woman and her therapist to manage more wisely.

# SYLLABUS OF TRANSITIONS FROM LOWER TO HIGHER FORMS OF PSYCHIC FUNCTIONS

| **The Lower Forms** | **The Higher Forms** |
|---|---|
| unilevel | multilevel |
| ahierarchic | hierarchic |
| automatic reflexiveness | deliberate reflection and autonomous behavior |
| motivation limited to stimulus-response system of drives | motivations based on intra-psychic determinants |
| first and second factor (determination by heredity and environment) primitive instincts (e.g., self-preservation, sex, aggression) | third factor (self-determination by autonomous dynamisms) higher instincts (e.g., cognitive, creative, self-perfection, empathy) |
| primitive levels of an instinct | higher levels of the same instinct (intra-instinctual development) |
| reality function limited to everyday life | creative reality function associated with retrospection and prospection |
| fractional, narrow understanding of reality | integral, broad understanding of reality |
| impulsive, temperamental syntony | reflective and meditative syntony (empathy) |
| intellect subordinate to primitive drives | intellect in harmonious conjunction and collaboration with higher emotions |
| subordination to primitive instinctive forces | autonomy |
| limited role of consciousness | significant role of consciousness (self-awareness) |
| relativism of values | universal hierarchy of values |
| selfishness | allocentrism |
| complete dependence on the biological life cycle | transcendence of the biological life cycle (e.g., sustained creativity and lucidity of the mind in spite of infirmity of the body) |
| limitation to innate psychological type | transcedence of innate psychological type |
| one-sided or "normal" development | universal and accelerated development |
| imitation of others, competition | originality and creativity |
| conformity | authenticity |
| adjustment to social norm | adjustment to norm from personality level |
| simple adjustment to actual situation in life (adjustment to "what is") | qualified adjustment and positive maladjustment (adjustment to "what ought to be) |
| feelings of inferiority toward others | feelings of inferiority toward oneself |
| training and education | education-of-oneself |
| heteropsychotherapy | autopsychotherapy |
| conjunction of volition with primitive drives | will as a function of personality |

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NOTE: We are looking for individuals to participate in a study of higher level development. If you know of individuals whom you believe to exhibit some of the characteristics of Levels III, IV or V, and who would be willing to complete a soul-searching questionnaire, (or if you have any questions about the theory) please write to:

Dr. Linda Silverman
Institute for the Study of
Advanced Development
139 East Florida Avenue
Denver, CO 80210

or

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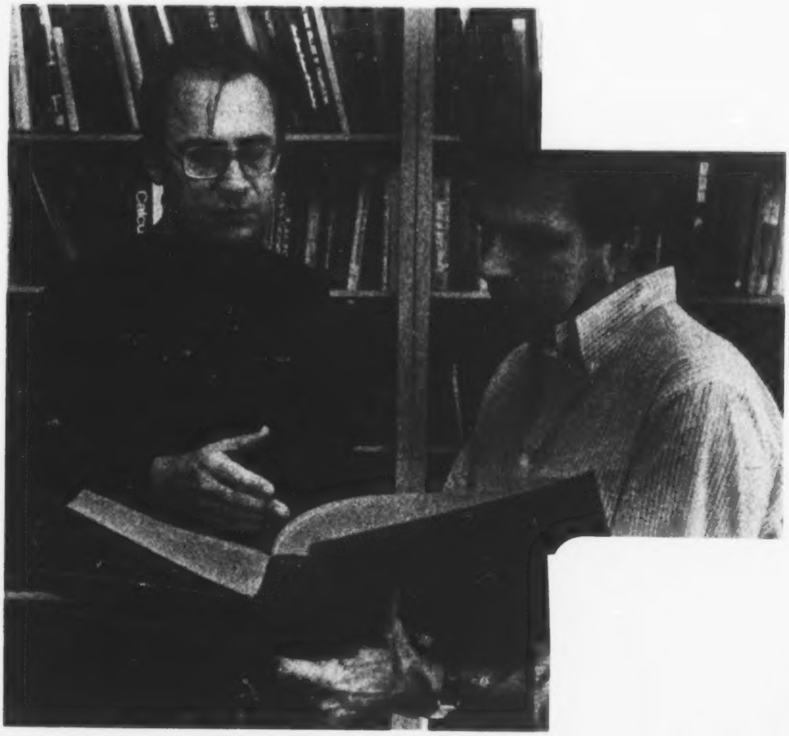

**Mentors:** Did You Have One? Could You Be One?
Gifted and Handicapped: Not an Oxymoron

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# MENSA 28
## RESEARCH JOURNAL

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**Staff**:

*Editor* • Phyllis Miller, 23 Lexington Road, Somerset, NJ 08873

*Assistant Editor* • Mary Hollifield, 1104 Mary Lane, Fort Oglethorpe, GA 30742

*Circulation Manager* • Karolyn Silliman, 19340 Dunbridge Way, Gaithersburg, MD 20879

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# Editor's Preface

In this issue, the *Mensa Research Journal* presents a mixed group of topics, ranging from a very structured, scientifically prepared article on "Cognitive Structures of the Gifted" to a more creative, intuitively prepared article on "Ecosynthesis: Creative Parenting Through the Use of Creativity, Imagery and the Will." You may not find yourself in agreement with everything you read, but agreement with everything is boring, and the MRJ strives not to be boring. Like Auntie Mame, we strive to open doors. Close them if you will, but look through them first.

Kathleen Spaltro has written an article on "Guiding the Handicapped Gifted Child to Achieve Potential" which, although it was originally presented to an audience concerned with handicapped children, speaks to all of us. We should listen. How do those of us who are not physically handicapped perceive those who are? Do we see handicaps and giftedness as mutually exclusive? People who know Kathleen know they are not; she is proof of what she writes.

And now, let me add my word about Margot. The first time I met her was at an AG for which I was handling publicity. I had booked her on a radio show and had set up an interview with a newspaper reporter, and was apprehensive about how she would feel about fitting these appointments into her busy three-day schedule. Well, she was charming, gracious, witty and informative—everything I thought a representative of Mensa should be. And she never did anything after that to change my mind. There are people who serve as role models even long after they are gone, and she is one of them.

Phyllis Miller
Editor

# Mensa PLUS Cart to Aid Science Education

Now available to over 10,000 school districts nationwide is an exciting new aid to science education at the elementary and secondary level: the Mensa PLUS (Physics Learning and Understanding Station) cart. This announcement comes after two years of project development, with a full year of school use.

PLUS could not have come at a better time, since the Sputnik-inspired science equipment additions to this nation's school system have long-since been used and discarded. Current economics preclude any major expenditures to replace or provide science classrooms with teaching aids. American science students continue to test poorly against those of the world's developed nations.

Against this background, the PLUS project is designed to stimulate student interest in science by making it fun again, and by appealing to multiple senses in a learning environment.

Based on "a picture is worth a thousand words," the PLUS cart is a mobile laboratory that enables students to visualize waves, vibrations and frequencies. It puts excitement back into science teaching and provides sophisticated electronic equipment to any school, and a program to use it, at virtually no cost.

## The Mensa PLUS Cart Itself

The equipment consists of an oscilloscope, signal generator, amplifier, speaker, microphone, switches, all interconnected on a rolling cart. The key to the PLUS concept is the oscilloscope, since it converts electrical input into visible waveforms.

Since the PLUS cart is portable, we believe that one PLUS cart can provide for the science training needs of a school building and even possibly a complex.

The Mensa PLUS cart can visualize human speech through sound waves, show the effect of sun rays and lights via photoelectric cells, demonstrate frequencies using tuning forks and signal generators, while tracing waveform characteristics of various instruments (violin, piano, flute, drum, kazoo) and overlaying their overtones and harmonics. The possibilities are endless, and do not require major expenditures for sophisticated computational equipment.

In fact, virtually all the equipment on the cart was obtained at no cost through donations of surplus equipment from local businesses. This partnership of business and education does work. While the equipment is sometimes considered obsolete, or has some circuitry that is inoperative, it usually can provide the simple functions needed for the Mensa PLUS cart. And there is much equipment available. In Binghamton, N.Y. (pop. 50,000), 13 carts were assembled with over 30 oscilloscopes donated.

## Experiments and Experiences with PLUS

The beta test group consisted of 11 PLUS carts which were provided to 11 school districts on permanent loan. As a condition of acquisition, each school sent at least one science teacher for a day of PLUS training. They also bussed in some of their top science students for a one-day PLUS familiarization, to help "seed" the use of the cart in the school.

Training started with the famous movie of the collapse of the Tacoma

Narrows Bridge, a textbook case and harrowing demonstration of the power that Nature can exert via wind and vibration. Following were simple wave-tank formations and the use of "Slinky" springs on the floor to generate waves and harmonics. Trainees then used their PLUS carts in experiments to calculate the speed of sound; find the characteristic output of regular vs. fluorescent lights; show AC vs DC currents, etc.

A discussion of other uses for the PLUS cart included teaching the deaf to speak, teaching musicians proper tone formation, etc. The science teachers were provided with a starting battery of experiments. Each also agreed to share added uses he originates. The originals plus additions to date are now available.

One of the most interesting sidelights to the training sessions was the excitement accompanying the thrill of discovery as each trainee made a comprehension breakthrough on his own.

**Acquiring Your Own Mensa PLUS Cart**

MERF is very proud to have provided funding to implement the PLUS project. We recognize the unique contribution of PLUS to science education and commend Jay Sarton, Science Director of the Roberson Center for the Arts and Sciences in Binghamton and Chief Astronomer of the Kopernik Observatory in Vestal, N.Y., who originated and developed the PLUS concept and project.

Mr. Sarton is interested in following through and supporting all PLUS cart users, and will provide exchanges of experiments and other information to those who contact him.

One condition of our grant was the requirement that no restrictions, patents, etc. be imposed on the replication of the PLUS carts by any public or private educational facility nationwide.

Accordingly, any institution wishing one may obtain its own PLUS cart(s). To aid this, MERF is making available the complete current PLUS manual, the reasoning behind PLUS, connection and usage schematics, a grouping of experiments and suggestions for soliciting business and industry, in the MERF Monograph Number 1. This Monograph is available for $5 from MERF, 2626 East 14th Street Brooklyn, N.Y. 11235-3992. For further information about the project, contact Jay Sarton, c/o Roberson Center, 30 Front Street, Binghamton, N.Y. 13905.

John B. Ceccherelli
former Mensa National Coordinator
of Gifted Children Program

# COGNITIVE STRUCTURES OF THE GIFTED*

*Michael F. Shaughnessy, Eastern New Mexico University, Portales, NM.*

What differentiates the "gifted" from the normal? This question has intrigued researchers, scientists, educators and psychologists for many years. In the past, the gifted have been seen as simply "more able," "brighter," "quicker" or simply "sharper" than others. With the advent of intelligence testing, an objective measure was used to differentiate the "gifted" child from the average or normal child, the "gifted" child being defined, for instance, as one scoring two standard deviations above the mean on an individually administered test of intelligence. Of course, other methodologies are often used for identification; e.g., teacher/parent nominations, achievement test scores, etc., but the Stanford-Binet Scale and the WISC, or more recently the WISC-R (Wechsler Intelligence Scale for Children-Revised) have both been the instruments of choice for final determination of giftedness. A simplistic way of viewing giftedness is simply to regard those scoring above 130 on an IQ test as "gifted."

As research with the WISC-R progressed, however, it became apparent that there were other considerations in evaluation besides test scores. Factor analysis has yielded three "factors." The first, "Verbal Comprehension," is based on the Verbal subtests of Information, Comprehension, Similarities and Vocabulary. The second factor, "Perceptual Organization," stems from four of the Performance subtests: Block Design, Object Assembly, Picture Completion and Picture Arrangement. The third factor, "Freedom from Distractability," is based on the Arithmetic, Digit Span and Coding subtests. This final factor is linked to attention span, concentration and the ability to avoid distractions.

The literature regarding factor analytic studies using the WISC-R has been extensively reviewed elsewhere (Shaughnessy & Jones, 1983) and more recently by Kroonenberg and Ten Berge (1985). However, two studies focusing specifically on the gifted should be mentioned. Karnes and Brown (1980) performed a factor analysis on WISC-R scores of a sample of 946 students (479 males, 467 females) ranging in age from 6 to 16, all of whom obtained an IQ of 120 or above. Factor analysis indicated that

- the two factor solution of the principal factor analysis paralleled the Verbal-Performance distinction set forth by Wechsler (1974),
- the Verbal subtests (with the exception of Arithmetic) loaded highly on a factor identified as a Verbal Comprehension factor (Kaufman, 1975),
- the Performance subtests (with the exception of Coding) loaded highly on a second factor known as the Perceptual Organization factor (Karnes & Brown, 1980).

Perhaps the most salient insight into the cognitive structures of the gifted has come from Sternberg (1985). He proposed a triarchic model of intelligence based on a componential subtheory, an experiental subtheory and a contextual subtheory. Several aspects of Sternberg's theorizing are germane to the cognitive structures of the gifted. First, Sternberg and Davidson (1982, 1983) have indicated that in the gifted, "insight" appears to differentiate their functioning from that of average students. Three processes appear to account for insight. These are (1) selective encoding, (2) selective combination, and (3) selective comparison. Selective encoding refers to the ability to discriminate between essentials and nonessentials, between the wheat and the chaff, so to speak, or between the professor's jokes and material that will appear on a later test. The gifted appear to attend selectively and to process information selectively, avoiding the "garbage in, garbage out" syndrome. Selective combination refers to the insightful ability of the gifted to "sift and synthesize" perhaps divergent or incongruous bits of information into a meaningful gestalt. The gifted can summarize and combine theories, ideas and hypotheses into a coherent paradigm or position. The selective combination may consist of themes, patterns, or threads, which when woven together create an exemplary tapestry of intellectual insight. Finally, selective comparison involves the relating of new data to past knowledge. The midget standing on the shoulders of a giant certainly sees farther, but the well read academician who can tie his or her work to the foundational work of others will secure a place in the eyes of academic posterity.

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* Reprinted from *Proceedings* of the Sixth World Conference on Gifted (1986).

These three processes are particularly germane in terms of "nonentrenched" or "novel" tasks (which the truly gifted handle with finesse) and in terms of "knowledge acquisition" both constructs again specified by Sternberg (1981, 1985). Thus, the gifted child is better able to cope with divergent tasks and "knowledge acquisition", both constructs again specified by Sternberg (1981, the world realm (general information and world knowledge). In addition, gifted superiority is linked to superior metacomponential skills (problem solving strategies, thinking about one's own thinking processes), to the greater "automatization" of processes that is observed in the gifted, i. e., the speed/rapidity with which they "process" information, and finally to the ability to apply expertise in specific domains. Of course, even among high IQ people there are differences in motivation, originality and task commitment. These perhaps extraneous variables (as well as "luck") may be operative in many situations.

Gardner (1983) offers yet another perspective on the "frames of mind" of gifted students. He argues that there are no fewer than six independent, autonomous "intelligences," which are culturally relative. Some cultures favor linguistic intelligence, the ability to deal with words and cope in the verbal realm. A separate intelligence may be musical, dealing with tone, pitch, rhythm and composition. The logical-mathematical domain is still another separate entity. Those who excel in dance, ballet, mime and acting may be demonstrating superior bodily kinesthetic intelligence. Spatial intelligence, the ability to deal with visualization and spatial relations, is another oft neglected realm of intelligence. The personal intelligences — interpersonal: the ability to deal and cope with other people, and intrapersonal: knowledge of oneself — are the final components of this theory of Multiple Intelligences (MI). Although Gardner does not directly address the thinking processes or cognitve structures of the gifted, he does examine exceptionalities (idiot savants, prodigies) and also lends support to his theory by drawing from recent research in neuropsychology.

In an endeavor to integrate such theories and research, one must attempt a metaanalysis and/or synthesis. Feldman (1980) seeks to go "beyond cognitive universals." He theorized that "there are four attributes that creative accomplishments of all varieties, including Piagetian universal achievements, seem to share in common" (p. 198). They are:

1. The initial consolidation of a newly reorganized structure or way of dealing with problematic situations is often accompanied by astonishment or surprise.
2. This solution, once achieved, often seems obvious, and one finds it hard to believe that it was possible ever to have thought differently.
3. As one moves toward a solution, there is often a strong, but difficult to describe, sense that the solution is "pulling" one towards it. This helps to account for the fact that one often "recognizes" the solution when one achieves it, almost as if one had known it all along, but had not quite been able to express it.
4. There is, finally, the irreversibility of a solution once it is achieved. While other modes of dealing with a problem do not necessarily cease to exist, the next solution expands for all time the available means for organizing experience. The solution will be taken as superior and applied to whole classes of relevant and often irrelevant problems.

These four attributes refer, of course, to creativity, and do not specify any structural framework from which to view the creative child's structures as a whole. Attempting to specify a framework from which to view the gifted, prodigies and other highly talented individuals is hazardous, particularly because of the wide range of abilities at the end of the bell shaped curve. The four basic assumptions of cognitive and development theory (universal achievement, spontaneous acquisition, invariant sequences and transition rules) are essentially veridical for all children, even highly gifted ones.

Posner and McLeod (1975) have indicated that structures represent enduring characteristics of the information processing system. They correspond to specific domains of cognitive activity. It seems that the gifted (1) process information more quickly, more expediently and more insightfully than others, and (2) are highly perceptive and insightful in their combining, comparing and encoding of information. The specific factors from which this results seem to be many and diverse. A rich environment, early stimulation, and nurturing parents, coupled with succinct mentorship, may result in a gifted child, yet not a prodigy. The above, although probably well known and commonsensical, has probably not as yet been formulated into a coherent, concise theoretical frame work. As Piagetian theorists have not addressed giftedness, an information processing perspective may be the only viable alternative.

Sternberg (1984) has indicated that between stage development is perhaps a fertile area for research into the cognitive structures of the gifted. "Differential efficacy" in a number of areas appears to discriminate between the gifted and nongifted. These domains seem to be:

(1) Accelerated acquisition — both of knowledge and between stage acquisition of Piagetian constructs;

(2) Accelerated automatization — the gifted child learns to perform rote mechanical operations more quickly and processes information at deeper levels with greater rapidity;

(3) Automatic activation — gifted thinkers more readily directly and indirectly activate componential processes (see Sternberg, 1984), and access both indirect and direct feedback more readily than others;

(4) There seems to be a greater depth and propensity of emotive alignment. Thus, the highly talented young musician more readily chooses a particular instrument (for instance, violin), form of music (e. g., Renaissance concertos) and develops a strong attachment to that domain more rapidly and strongly than less gifted peers. This metaphor can be used in any domain; e. g., history, medieval art, French literature;

(5) A secondary aspect of the above is intrinsic interest/inquisitiveness. This interest maintains the love for the subject area mentioned above, and sustains long term growth;

(6) Finally, componential chunking or metaanalysis (or both) provide greater potential for problem solving, investigation and solution production. This encompasses higher order abstraction, evaluation and synthesis.

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# MENTORING THE CREATIVE CHILD, ADULT AND PRODIGY: CURRENT KNOWLEDGE, SYSTEMS AND RESEARCH*

*Michael F. Shaughnessy, Eastern New Mexico University, Portales, NM.*

## ABSTRACT

The process of mentoring has been utilized in many fields. It has, however, been most dominant in the realm of the creative arts. This paper explores the process of mentoring relative to the creative child, adult and prodigy. Our current information relative to this process will be examined as will current research. Needed areas of research are indicated for future mentors.

Why don't you work with Michelangelo? Can't you study with da Vinci? Maybe Chaucer can help you. The previous questions all reflect infinite possibilities. The opportunity to learn from an established figure has, of course, reflected the epitome of the mentoring process. However, mentoring in the creative realm differs greatly from academic and corporate mentoring. This paper will explore mentoring relative to creative children and adults and overview the state of knowledge relative to the field. This author posits that there are very succinct differences in terms of mentoring the "creatives," as opposed to other proteges. These differences are often accentuated by the nature of the creative process and by the personalities involved. Further, developmental trends of artists, musicians and others may need to be considered. Finally, emotional agendas may also need to be addressed.

## MENTORING THE CREATIVE CHILD

Creative potential is often ascertained in youth. An observant parent or teacher may perceive some skill, talent, or ability not available to the average youth. Typically a haphazard referral is made, or some attempt implemented to encourage that ability. All too often those efforts fail, due to a number of reasons. However, when a creative child is linked with a supportive mentor, the results can be phenomenal.

Creative children, of course, present difficulties not faced by other mentors. Their zeitgeist differs, frustration tolerance is lower, long range goals are ambiguous at best. E. Paul Torrance (1984) has explored the realm of mentoring, and has also indicated difficulties relative to mentoring. However, the bringing of creative potential to fruition, or at least encouraging its growth, is, in fact, its own reward.

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* Reprinted from *Proceedings* of the First International Conference on Mentoring.

The positive characteristics of a mentor have been seen to be different for males and females (Torrance, 1984). Males appear to respond to a mentor who is skilled and "an expert." They report the mentor as "a friend...encouraging, prodding and respectful." Finally, "committed, dedicated, hard working, and honest" were traits linked to the mentor. The females appear to have different traits, such as "encouraging, praising, skilled expert, a friend,. inspiring and energizing." They were seen as being "supportive, acknowledged talent, confidence giving, caring, interested and persistent."

These differences may be due to some basic male/female differences as noted by Gilligan (1982) or perhaps due to the fact that women are still establishing themselves in positions of authority. In any case, the mentor must be regarded as a person with specific skills, encouragement being one of these skills.

Encouragement in the creative realm must be constructive and occasionally genteel. The mentor must be more cognizant of the creative child's foibles and weaknessess and combine instruction with support. Expectations must be judiciously guarded. Being a role model is tolerable; holding up another more accomplished artisan as a role model may result in dismay and discouragement.

Early identification of the "creative" child seems imperative. The research (Torrance, 1962, 1965) seems to indicate that creativity can be squashed by third or fourth grade and may never return. Mentors of children owe it to their mentees to try to arrange for a consistent pattern of mentoring for grade school children. Children, of course, do not always see teachers as mentors or the teaching process as mentoring. However, the mentor's duty is to foster the process of growth and endeavor to insure that the creative gifts are maximized.

Many schools and parents seeking to service gifted/creative and talented children often plan a mentoring program. Cox and Daniel (1938) have offered the following germane ideas:

1) Select a coordinator who has access to an administrator at the decision-making level.

2) Specify the purpose of the mentorship and the role of the students.

3) Elicit the support of the district superintendent, the school board, and community leaders.

4) Prepare written criteria for student selection based upon multiple indices, not just one.

5) Develop a clear, defensible academic credit policy. If high school credit is given, the work experience should relate directly to the course for which the credit is received.

6) Try to achieve the best mentor/student match possible. Mentors should be creative producers who will not treat the students as "go-fers."

7) Orientation seminars should be planned to acquaint students with the professional and business environments in which they will work.

8) Students should be prepared for the mentorship with related course work prior to the experience.

9) Students should be helped to develop individual goals.

IO) Mentors should be asked to help evaluate each student's work.

11) The program must meet the academic needs of students. Students should be assigned required reading; they also should keep journals in which they analyze their activities and experiences (cited in Rimm and Davis, 1985, p. 148).

## PARENTS AS MENTOR TO THE CREATIVE CHILD

Unfortunately, as more and more parents become aware of their children's creative strengths and potentials, the weaknesses of our educational systems and the lack of competent mentors become increasingly apparent. Painters, sculptors and creative writing teachers are few and far between. College professors have committee work, courses to teach and advising to perform. Parents thus have assumed greater and greater responsibility for the rearing and education of their children. This perspective has been explored by Shaughnessy and Heacock (1985) and by Shaughnessy, Neely and Azubike (1986). Essentially, in many rural areas of limited resources and few specialists, parents must act as mentors in terms of encouraging their children's artistic growth. Parental support groups are often found in many states and projects revolve around effective parenting and mentoring.

The "parent as mentor" position has both advantages and disadvantages. On the positive side, the parent can grow creatively and is much more "in touch" with what the child is doing. On the other hand, role overload may result and the parent, not being "an expert," may not have the skills and abilities to truly foster the growth of the child. The parent may not be totally objective relative to the child's abilities. Insightful parents may recognize the "point of diminishing returns" and make adjustments, e.g., relocation from a rural area to an urban cultural center. They may further seek out experts and foster a mentor relationship.

## MENTORING THE CREATIVE ADULT

The adult, of course, presents many more and different challenges than the child. The rewards may also be more immediate and impressive. Further, the adult more readily seeks out a mentor for improvement of his/her work. The work can be art, music, writing or research (Shaughnessy, 1984). However, the amelioration and growth of creative work takes an entirely different dimension from that of the child.

The adult mentor is qualitatively more aware of "standards" and of the intricacies and subtleties of the creative endeavor. The teacher/pupil relationship is diminished and a more egalitarian perspective is assumed. The mentor is still the expert but the protege may see cracks in the armor. There may, in some cases, be competition. In fact, Levinson (1978) often found short, abrasive masculine mentoring relationships.

Emotionally, the adult mentee has greater depth and this emotional depth may be a valuable strength to be called upon (Shaughnessy, 1983). Further, adult mentors may advise the proteges from a number of differing perspectives (Shaughnessy, 1984) and thus be more flexible and adaptable in their approach. E. Paul Torrance (1984) has suggested the following seven items for mentors to help creatively gifted youth, which can certainly be applied to adults:

Help them to:

1. Be unafraid of "falling in love with something" and pursue it with intensity and in depth. People are motivated most to do the things they love and can do best.

2. Know, understand, take pride in, practice, use, exploit and enjoy their greatest strengths.
3. Learn to free themselves from the expectations of others and to walk away from the games that others try to impose upon them.
4. Free themselves to play their own game in such a way as to make the best use of their strengths and follow their dreams.
5. Find some great teachers and attach themselves to these teachers.
6. Avoid wasting a lot of expensive, unproductive energy in trying to be well rounded.
7. Learn the skills of interdependence and give freely of the infinity of their greatest strengths (pp. 56—57).

The adult may need even greater amounts of emotional support and perhaps even financial support. Familial and marital problems may hamper creative progress. The mentor must be aware of these setbacks, yet consistently support and encourage the emotional growth of the protege.

## MENTORING THE PRODIGY

Although few and far between, real prodigies do in fact exist and skilled professionals may expect to be consulted regarding the education of said prodigies. Essentially there is little written about prodigies and even less about the process of mentoring to these children. David Feldman (1980) has written on the theoretical/developmental aspects of prodigies while Howard Gardner (1983) has written on brain research relative to prodigies and some practical educational methods, i.e. the Suzuki Talent Education Method. This author (Shaughnessy, 1986) has endeavored to synthesize some of our notions regarding the cognitive structures of highly gifted children.

It is difficult if not impossible to discern the talent and potential which goes untapped due to lack of a willing mentor. Some issues which must clearly be discussed with parents of prodigies (and later, prodigies themselves) follow:
1. Parents need to recognize their own (and early mentors') limitations and inexperience. Parents must acknowledge that if they have pursued chess as a hobby, they cannot teach a prodigy to be a grand master. Local "mentors" in a music shop must also realize when a child must go to attend Juilliard School of Music or the Boston Conservatory.
2. Parents must be willing to relocate. Prodigies cannot flourish in Chadron, Nebraska. The stimulation of a cultural center such as Chicago, New York or San Francisco must be sought out.
3. Play must not be neglected. Children also need to play in the mud, get dirty, pitch baseball and shoot hoops periodically.
4. Expert advice must be sought out and contact maintained. Specialists are few and far between. They will, in effect, be "mentors" of sorts to parents. Their advice, recommendations and support are invaluable.
5. Don't expect overnight success. Parents must temper their expectations. Granted, a four-year-old playing Mozart is impressive. However, the road to "concert pianist" is long and arduous.
6. Don't neglect other siblings and their gifts and talents. Don't create a neurotic

brother or sister via constant comparing and bragging. Try to keep the family intact as a "reservoir of meaning" (Shaughnessy, 1983).

7. Although a child may have different talents, skills and abilities than others, the prodigy is no better than other less talented human beings.

At the present time there is very little research on mentoring to prodigies. There is little on the process of teaching prodigies. This seems to be a much neglected area in need of future research and investigation.

## ON BECOMING A MENTOR

Many times, due to circumstances, one must become a mentor at least temporarily. There may be a dearth of capable people, indeed, there may be no one else ready, willing and able to support a younger person with potential and ability. Collins (1983) has offered the following guidelines:

1. "Don't wait to be asked."
2. Recognize that mentoring is good for oneself and for one's organization.
3. Recognize talent early.

Although her text is generally business oriented, the guidelines offered are applicable in most fields. The skilled, insightful person can usually recognize skilled younger others and generally can initiate a relationship early on.

In such situations, one is left to one's own devices to learn on the job and obtain practical experience in this manner. Mentors should be able to give of themselves emotionally. They must be able to deal with frustration and aggravation. Further, they should be careful not to use their proteges as mechanism of vicarious pleasure.

## TOWARDS PROFESSIONAL MENTORING?

Facilitating the creative child's potential and growth is of course, a time consuming affair. Both the mentor and protege profit. However, as "experts" are few and far between, should we move toward the establishment of professional mentors? This writer has periodically set up students with mentors. Elementary and secondary high school students have benefited from their relationship with their mentors. As we become more and more aware of children's talents and abilities, and the benefits of mentoring, should we be establishing professional paid mentors?

Certainly the relationship may change. The mentor may become an outside instructor. Time constraints on professionals are of course a reality. Experts need to be reimbursed for their expertise, yet the fiscal element may damage or change the relationship. Certainly, in some esoteric fields it may be necessary to pay an expert for specialized knowledge.

## SUMMARY AND CONCLUSIONS

Briefly, this paper has endeavored to review some of the main issues in mentoring in creativity. Mentoring to the creative child, adult and prodigy has been cursorily reviewed. Much still needs to be done in terms of empirical research in order to maximize the benefits of the mentor/protege relationship.

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# VERBAL INTELLIGENCE AND SOCIAL MATURITY AS PREDICTORS OF READING ACHIEVEMENT IN CHILDREN*

*Ralph R. Behnke, Texas Christian University; Elaine Fowler, University of Texas at Austin; and Karl W. Krayer, communication specialist, Dallas, Tx.*

## ABSTRACT

While global integration or intelligence has been established as a reliable predictor of a wide range of learning abilities, including reading comprehension, the relationship between intelligence and performance remains a modest one. Social maturity, which features characteristics such as self-control, self-direction, and self-sufficiency, is posited as a predictor of reading achievement, one which is independent of verbal intelligence. The results of this study support the hypothesis that verbal intelligence and social maturity are significant and independent predictors of reading achievement in children.

## RATIONALE

Reading ability is positively related to the level of global integration which is roughly equivalent to general intelligence. Higher intelligence generally produces higher learning abilities but the relationship between the two is a modest one. In fact, the variance in learning abilities accounted for by global integration or intelligence is only about 22 percent. Consequently, 78 percent of the variance is attributable to factors other than intelligence. Intellectually superior children, therefore, will not necessarily function at expected global levels (Jastak and Jastak, 1978, p. 68).

In addition to being influenced by intelligence, reading achievement is related to motivatonal factors (Briggs, 1986; Garner, 1986). Inattention, distractibility, and lack of self control serve as negative factors. Moreover, when language and reading disabilities occur simultaneously, the impact of motivational factors, such as purposefulness and channeling of energy, is enhanced further (Jastak and Jastak, p. 67). Because intelligence alone is only a modest predictor of reading achievement, social maturity, including freedom from need for assistance, direction or supervision, is posited as having significant explanatory power in the study of reading effectiveness (Herber and Nelson-Herber, 1987; Moore and Moore, 1987; Baumann and Ballard, 1987). The concept of social maturity, represented by the Vineland Social Maturity Scale, (Doll, 1965) centers on the extent to which children demonstrate the capacity for developing independence and maturity in matters of self-direction. self-sufficiency, communication, and social participation. In this view, social maturity is conceptualized as independent of intelligence, skill, or achievement, focusing instead on children's propensity for generating independent behavior (Doll, 1965, p. 7).

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Clearly, the development of effective reading skills is a function of both formal instruction and independent practice. Children who demonstrate the traits associated with social maturity need less assistance, direction and supervision, characteristics equally useful in acquiring skills in required classroom activities, homework assignments and independent reading.

Based upon the preceding rationale it can be hypothesized that verbal intelligence and social maturity are significant and independent predictors of reading achievement in children.

## METHOD

### Subjects and Procedure

Participants in the study were 254 third to eighth grade elementary school students divided about equally among the six grades. Average age was 10.8 ranging from 8 to 13 years. Intelligence, social maturity and reading achievement tests were administered on separate days to reduce fatigue and the probability that students would associate the tests with one another.

### Instrumentation

Intelligence in this study was operationalized as a score on the verbal component of Wechsler Intelligence Scale for Children (WISC). Social maturity was measured by the Vineland Social Maturity Scale (VSMS) and reading achievement by the reading subtest of the Wide Range Achievement Test (WRAT). These instruments were selected because their reliability and validity are well established, they are commonly administered by school system psychometrists and they were designed for the age levels of the participants.

## RESULTS

Participants in this study appear to comprise a normally distributed sample of the general population with regard to their verbal intelligence, with a mean score of 99.97 and a standard deviation of 13.61. A multiple-variable statistical procedure with reading achievement as the dependent variable and intelligence and social maturity as predictors was carried out. The results show a multiple-r of .53; $r^2=.28$; p=.OOl, indicating that verbal intelligence and social maturity combine to account for 28 percent of the variance in reading achievement scores. The correlation between verbal intelligence and reading achievement scores was r=.498; $r^2=.248$; p=.OOl. Intelligence accounted for about 22 percent of unique variance in the model. Social maturity and reading achievement showed a correlation of r=.3O6; $r^2=.093$; p=.OO1, with social maturity contributing about 6 percent unique variance to the prediction equation. Consequently, these results support the hypothesis that verbal intelligence and social maturity are significant and independent predictors of reading achievement in children.

## DISCUSSIONS AND CONCLUSIONS

Overall, the results cited above lend empirical support for the rationale advanced at the beginning of this report: that the variability in reading achievement scores can be reliably predicted by global integration or intelligence, but only at a moderate level. Because children vary considerably in their achievement motivation, and because they vary in characteristics such as self-control, self-direction, and self-sufficiency which are related to reading achievement, these social maturity factors are independent of intelligence. Therefore, social maturity, logically, should add unique explanatory power to the proposed model. In fact, the findings clearly support this theoretical proposition.

From a more practical, application-oriented perspective, further research is needed to refine the operationalization of social maturity. The contribution of social maturity to the prediction of reading achievement levels, while both significant and substantial, should be expected to rise with further refinements of the measure. For example, individual elements of the Vineland instrument should be correlated with reading performance to determine their predictive power, resulting in a refinement of the social maturity measure. Moreover, other measures of social maturity should be evaluated for this purpose.

Further research is needed to extend the generalization of these findings and to document the determinants of reading achievement as well as the sources of social maturity.

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# ECOSYNTHESIS: CREATIVE PARENTING THROUGH THE USE OF CREATIVITY, IMAGERY AND THE WILL*

*Gladys Ostrom is an art therapist with Creative Artistic Training, Schenectady, NY.*

This article is dedicated to the parents of intuitive, gifted, creative children who have higher octaves of perception with which they may be endowed to lift evolving humanity into greater awareness.

## ABSTRACT

Imagery is the key to parenting the intuitive, gifted, talented and creative child. It is necessary now and in the future to have imagery techniques in order to reach our future geniuses. One definition of genius is the ability to visualize your objective with a goal in mind. This statement needs to be fully realized in order for parents of intuitive, gifted, talented and creative children to understand how to relate to their children. The paper will describe how to conduct imagery workshops using drawing, dancing and writing along with music.

The synergy of creativity, imagery and the will is being taught as a new science of peace called Ecosynthesis. Imagery training through the use of "Imagery and Mandala" workshops teaches children to develop the use of visual, kinesthetic and audio imagery as a paradigm for understanding a relationship to themselves and to the environment.

The "Imagery and Mandala" workshop is the training method of Ecosynthesis. Through drawing, writing, and dance, the mind is led into action. The drawing encompasses a circular image which represents the child's present and ideal relationship to his or her body, mind, emotions, impulse and desire, imagination, intuition and essential-self.

Ecosynthesis is a new dimension in imagery awareness which takes place through the connection with the transpersonal will. The relationship of the transpersonal will to the creative process through the repetitive "Imagery and Mandala" exercises helps to evolve the will.

A new understanding of will is needed both on a personal and transpersonal level in order to do this work. The old Victorian idea of will and power over people needs to be eliminated. Will is a connecting factor with the "I" part of

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yourself. This "I" and "will" work together to have the controlling element over all the subpersonalities. Further connection with the transpersonal will make it possible for the senses and the all-inclusive intelligence to be balanced. Working through a repetitive "Imagery and Mandala" exercise creates a blueprint of the child's life. The awareness of oneself on an imagery level evokes a new creative faculty with which to explore the environment.

Ecosynthesis is the concept of the synthesis of economy, ecosystem and ecology which is based on the need to develop an imagery tool in which children can learn to relate to nature in a new way. It embodies the whole breadth and depth of experience as a new vision.

At this point in my article writing, I was interrupted by Matthew, one of my eight-year-old twins, who came in the room to ask what I was doing. I said I was writing an article for *The Creative Child and Adult Quarterly* and asked if he would like me to read what I had written. He said, "Yes," and I proceeded to read the beginning of this article to him. When I finished, I asked if there was anything he didn't understand about it. He said, "Yes, I don't understand synthesis." I said, "Well, synthesis is sort of like blending two or more things together to come up with one thing." He said, "You mean like blending red and yellow to make orange?" I said, "Sort of like that."

Right then, Matthew seemed distracted and I thought I had lost his interest completely. He said, "What's that?"

"What do you mean?" I said.

"That noise?"

There was a high pitched shrieking noise from outside the window.

"That's a bird," I said, and then I said, "Hi, bird," in a sing-song voice back to the bird. The bird chirped back at me again. Again, I said something back to it. This went on five or six times and each time the bird chirped back to my remarks.

Matthew and I were both smiling, when I said, "Did you hear the bird with your ears?" He said, "Yes, but I also felt the bird's vibration all over the top of my head." That was the way it was feeling to me, too. I sat there amazed. What a synchronistic, synergistic, ecosynthesis experience. That was just what I wanted to express to him, to explain my feelings of what ecosynthesis meant to me: a total blending of our minds with one or more elements of nature.

The evolution of mind expanding to a point of creative imagery awareness of nature is achieved through repetitive imagery exercises. Before parents and educators can realize the significance of this method of ecosynthesis there needs to be a paradigm shift in our present way of viewing the human being. Western models have viewed the self as individualistic, dualistic and mechanistic while overemphasizing rational thinking and analytic language. It is necessary to return to our experiences which precede our analytic distinctions. There is a need to develop a holistic and relational vision of the person. We need to look at reality as a paradoxical and mysterious unity which underlies and interacts with our separateness, while viewing both aspects as equally valid.

A self/not-self approach is proposed for viewing the person as an integration of the transpersonal, interpersonal and intrapersonal dimensions of human existence. The basis of viewing both unity and separateness within each of these dimensions is accomplished through Ecosynthesis Training.

"We must prepare men for the new world which is spontaneously building itself around us as a phenomenon of evolution: we must make them conscious of the new life which is coming about, in order that they work for it. At the same time we must gather together all the elements of this new world and organize them into a science of peace" (Montessori, 1948, p. 32).

Humanistic philosophy, the vision of the human as a unique being capable of personal and collective growth, self-determination and transformation, is gathering strength around the world. This is a critical time to continue to support the growing coalition, with the commitment to work together to nurture, celebrate and help to heal our planet.

Through Humanistic education and philosophy we must reach out to the population to enlighten them in the Wholistic process, teaching self-esteem and commitment to themselves, society and the planet, creating a breakthrough in which we will begin to look on man as a new creative being. Through Transpersonal education man will begin to "Integrate his three fields of energies and to higher fields, the fourth field with which he makes a link with his higher self. There are creative ideas on this level which help in the evolution of the human kingdom. Man with higher octaves of perception can pick up these concepts, make use of them and lift the evolving humanity into greater awareness" (Bolen, 1973, p. 30).

It is not enough for us to be mindful of the phenomenon of evolution. The concept of the humanistic and transpersonal process captures all of our attention which has the power to unify mind and body. This "mindfulness is a silent, nonperforming witnessing of the movements of our thought, feeling and sensation. But at another level it is power to act from the living center of our being. This is called will" (Needleman, 1965, p. 166).

"The will is the man and if the will is restricted or held in dominance by another, the individual ceases to exist as a thinking, reasonable being. Man must understand the forces of his being and control those forces to bring about the desired effect in his life" (Adamski, 1972, p. 54).

"The will is the controlling element of man's being, the element that makes the individualized consciousness a man or beast, god or devil" (Adamski, 1972, p. 54).

If the emotional instinctual sides of our nature are not harmonized with the will, all attempts to humanize science must necessarily fail. We must not only turn to humanistic and transpersonal ideas and ideals, but serve in the creation of harmony and psychic force within man, with a will to organize them into harmony.

As David Spangler so beautifully says it, "Re-cognize, know again. There must be this openness of consciousness if we are to fulfill the reality of a 'New Age'...Man's consciousness through the ages, from the moment when he first awakened as an individual and began to compare himself with his environment, has sought to become identified with the Divine processes flowing within himself so that he could be free, free to be the process and not an effect of the process, not a product of the process. That is what the 'New Age' is all about: man learning in consciousness to be the living process of the Divine in the moment, of himself in the moment, of what he is in the moment, and allowing everything else to take its place accordingly. As he becomes aware of what he is and what others are, as these are blended together, the forms become obvious...It makes little difference whether he is building a theater, a pot, or a cesspit; whatever he is building, it is the consciousness that is important. Form is not so important, except simply as an exercise in which consciousness can develop and learn to express itself" (Hawkin, 1976, p. 308–311).

As man has tried to learn to express himself through the ages, he has on occasion tried to turn lead into gold. The earliest alchemists were known to be processors of such knowledge. Now, man is turning ideas into gold through goal setting.

The following are some of the ideas set forth by Roberto Assagioli in his collection of basic writings on Psychosynthesis, in which the use of the will is stressed. "Pyschosynthesis is the Formation or Reconstruction of the Personality around a new center...Some people have a distinct vision of their aim from the onset. They are capable of forming a clear picture of themselves as they can and intend to become...it concentrates the energies and utilizes the great suggestive and creative power of images. Other individuals of a more plastic psychological constitution who live spontaneously, following indications and intuitions rather than definite plans, find it difficult to formulate such a program, to build according to a pattern. They may even positively dislike such a method... Some take a similar attitude but express it in a different way; they speak of tuning in with the cosmic order, with the universal harmony, of letting life act in and through them" (Assagioli, 1977, p. 26–27).

Once the type of person you are has been discovered, it is necessary to look at the various aspects of the will itself.

Roberto Assagioli used the following principal aspects of will to give a new outlook on the will: strong will, skillful will, good will, and transpersonal will. It is necessary to have all aspects of the will understood in order to undertake challenges which involve total commitment and dedication.

"Great is the power of images, and they can be said to constitute a necessary intermediary between the will and other psychological functions. The will can learn to direct the imagination to a considerable extent: to achieve this, systematic exercises and training are very helpful. The will can encourage the intuitive operation by formulating questions to be addressed to the superconscious sphere, the seat of the intuition" (Assagioli, 1977, p. 194–195).

The following "Imagery and Mandala" exercise was used as part of the Ecosynthesis Training in a group workshop with children participants. The music that was used was Steve Halpern's *Zodiak Suite* and *Spectrum Suite*.

**I. Body Section**

| | |
|---|---|
| | Relaxation |
| 2 min. | A conscious seeking form, part of the life force of the universe and finally a baby. |
| 1 min. | Play music. |
| 3 min. | Watch the evolution of the physical form of this consciousness, how it grew, what it did, where its challenges were. |
| 1 min. | Age 2, 5, 7. |
| 1 min. | See yourself at the present time in physical realm. |
| 1 min. | Allow an image to appear. Ask it what it needs to transform and develop to a more integrated level. |
| 1 min. | Now write about, then draw a representation of your experience |
| 30 min. | Writing and drawing |
| 1 min. | Stand up and find a position to reflect this image. Experience through movement |

this physical body getting what it needs and the image transforming to an "ideal model" for your physical reality. Find a new position to relate to this "ideal model" and allow a new image to develop for this position. Play music.

3 min. Allow the music to solidify this transformation and to fully experience your ideal state.

1 min. Now write about, then draw a representation of your experience.

## II. Emotion Section

Relaxation

2 min. SADNESS, ANGER, JOY, PEACE, FEAR, LOVE

1 min. Play music.

3 min. We have many emotions, ways of expressing our moving experience, emotion meaning "from motion."

1 min. Think back on your life.

1 min. What was your emotional expression as a child.

1 min. Allow an image to appear to reflect your present relationship with your emotions.

1 min. Ask it what it needs to develop to a more integrated level.

1 min. Now write about it, then draw a representation of your experience.

30 min. Writing and drawing

1 min. Stand up and close your eyes. Find yourself in a meadow. It is a sunny day. In your hands you hold the symbol for your emotions. As the music plays - Play music - Begin to dance. Experience the sun shining on your symbol and as you move watch it transform to an "ideal model" for your emotional reality, a new symbol for your feeling state.

3 min. Now write about, then draw a representation of your experience.

## III. Impulse and Desire Section

Relaxation

1 min. Impulse and desire, that which contains our inner fire, our want for more, our movement towards procreation, creation. Play music.

3 min. Think back on your life over the past years, what is your relationship to the impulse and desire nature.

1 min. Allow a symbol to emerge which reflects this relationship.

1 min. Ask it what it needs to develop to a more integrated level.

1 min. Now write about it, then draw a representation of the experience.

30 min. Writing and drawing

1 min. Stand up and close your eyes. Find yourself in a position to reflect your image. Allow yourself to begin to move in place, experiencing the energy of this inner fire. Play music.

3 min. Refine your movements, experience the freedom and wonder of this life force moving through with power, peace and ease.

1 min. Come now to a new position.

1 min. Allow an image to come for your "ideal model" for your impulse and desire nature.

1 min. Now write about it, then draw a representation of the experience.

## IV. Mind Section

Relaxation

1 min. Thinking, reflecting, creating, organizing, problem-solving, ah-ha, mindfulness, no mind, one mind.

Play music.

3 min. Think back on your life over the past years, how has your mind developed.

1 min. What are its strengths and weaknesses?

1 min. How does it serve you?
1 min. Allow yourself to produce a symbol to reflect your current relationship to your mind.
1 min. Ask it what it needs to develop to more integrated level.
1 min. Now write about it, then draw a representation of the experience.
30 min. **Writing and drawing**
Stand up and close your eyes.
1 min. Move around the room showing through movement your current relationship with your mind.
1 min. When you hear the tambourine . . . change to a new dimension of your mind and repeat out loud a word which reflects this dimension.
2 min. Now stop and imagine that your mind is growing and developing, refining, expanding.
1 min. Begin to move to reflect this expansion, experiencing it in your whole self. Play music.
3 min. Stop now, sit down and allow a new image to emerge for your "ideal mind" . . . Now write about, then draw a representation of your experience.

### V. Imagination Section

Relaxation
1 min. Images, imaging, dreams, daydreams, nightmares, fantasy, myths, symbols. Play music.
3 min. Think about the development of your imagination.
1 min. As a child.
1 min. Do you believe it is available to you?
1 min. Allow yourself to produce a symbol to reflect your current relationship to your imagination.
1 min. Ask it what is needs to develop to a more integrated level.
1 min. Now write about it, then draw a representation of the experience.
30 min. **Writing and drawing**
Stand up and close your eyes.
1 min. Move into a position reflecting your current relationship to your imagination.
1 min. Imagine that any veils around your imagination are being lifted and you are expanding your imaginative capacity. Play music.
3 min. Dance to this expanded capacity. As the music ends allow a new image to emerge, an image for your "ideal imaginal self."
1 min. Now write about it, then draw a representation of the experience.

### VI. Intuition Section

Get into partners. Sit opposite each other. Choose an "A" and a "B." "A" closes his/her eyes. "B" repeats the word "intuition" and records "A's" responses. After five, roles are reversed. Partners take back their lists and circle in red areas they feel adequate in regarding their intuition and in blue areas of their intuition they would like to develop. Close eyes and allow a symbol to appear to reflect their current relationship to their intuitive nature.
3 min. Now write about it, then draw a representation of the experience.
30 min. **Writing and drawing**
Close your eyes. Experience physical relaxation throughout your whole body.
1 min. Now allow your emotions to be calm like a rough sea settling to gentle state.
1 min. Now allow any thoughts you had to be toned down and quieted as if you were turning down the volume knob on an internal radio receiver.
1 min. Physical relaxation, emotional calm, mental quiet.
1 min. Stay with this state of deep intuitive perception. Allow your intuition, your inner knowing, to evoke an image reflecting your "ideal intuitive state."

1 min. Stay with this image, take it into your whole self, breathe with it, allow it to fill your entire self.
1 min. Now write about it, then draw a representation of the experience.

### VII. Essential Self Section

Play music
3 min. You stand at the bottom of a translucent golden staircase.
1 min. The staircase leads into the higher and deeper dimensions of your Self. There you stand with your body, your emotions, your impulses and desires, your mind, your imagination, your intuition, your will.
1 min. You are an empowered and loving being, knowing that you can say "I am" and knowing that you are more than any of these words.
1 min. I am that I am.
1 min. Imagine your Self now climbing up this staircase. As you take each step experience your Self becoming more one with your true Divine Nature—filled with light and love and power, part of an unfolding mystery through the ages.
1 min. When you reach the top you will find a symbol to guide you toward the unfolding of your Divine Nature.
1 min. Be with this symbol, embrace it, be one with it.
Play music.
3 min. Now slowly begin to stand up. Really embody this symbol allowing the music to move your entire being.
1 min. Now write about it, then draw a representation of the experience.

"Imagery and Mandala" workshop was used spending about two hours on each section. Mark and Matthew, my identical twins, were seven years old when they drew their first mandala.

One year later the exercise was repeated going over the total experience in two and-a-half-hours. The exercise was simplified by using only the first part of each section and allowing only 15 minutes per section. Matthew followed along and kept pace with each section. Mark drew an enlargement of the essential-self center.

Here are the five ingredients which will help to bring about goal setting through imagery and the will.

1. Desire - an intense desire to reach a chosen goal. We must give intensity to our lives in a way that can allow reality to be part of what the cosmic center wants. We understand this want through an image we perceive.
2. Concentration - we must be able to direct our fields of attention to our desired goals, to focus on what the center wants, keeping all negative suggestions and "ego-chatter" that would interfere in what our centers want for us in our lives.
3. Belief - we need total inner certainty and utter conviction that we cannot fail in any area of life.
4. Will - the will must be acutely directed toward achievement of our goals. Without will power there can be no impetus for achievement.
5. Action - some form of action is necessary to put the image into action. Man achieves his goal through his will in unison with the Divine, achieving the knowledge and power to bring desired things that are imaged into manifestation through conscious self-awareness.

As more and more people begin to understand the transformation of Ecosynthesis they will begin to realize the potential of the new alchemy. Man's will, in union with the transpersonal will achieving the knowledge and power to bring desired things into manifestation through conscious self-awareness, is the secret to creativity, imagery and the will.

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# GUIDING THE HANDICAPPED GIFTED CHILD TO ACHIEVE POTENTIAL

*Kathleen Spaltro—herself a severely hearing-impaired writer, editor, and teacher of writing—presented these ideas at the July 1989 annual conference of Supporting Emotional Needs of Gifted [SENG] in St. Louis. She is a member of the Mensa Education and Research Foundation Board of Trustees.*

In discussing how we may guide the gifted handicapped child to achieve potential, I would like first to discuss each element of the topic in isolation—what situation does the handicapped gifted child live in? how do we understand—or, more exactly, misunderstand—what achievement means for such a child?—before arguing that our promotion of self-acceptance as a handicapped gifted person will most effectively insure that child's achievement of potential.

The situation of the handicapped gifted child abounds in contradictions and double-binds. Most people see the disabled as inherently inadequate. Disabled people who succeed do not alter that perception of other disabled people; by succeeding, in other people's minds [though not in fact], they leave behind their disability. If our society tends to stress the helplessness of disabled people, it at the same time expects gifted people to succeed without understanding or support; supposedly, they have no struggles or limitations or inadequacies. Who could resemble so little the struggling, limited, inadequate handicapped? If the handicapped person, in many people's eyes, cannot succeed, the gifted person—under similarly unperceptive eyes—cannot *not* succeed. A handicapped gifted child, then, lives a paradox: how can a gifted person yet remain essentially inadequate as well? how can one who needs no help need endless help?

Other people, therefore, bombard the gifted handicapped person with mixed messages. Those who most perceive the giftedness ignore the handicap's making success even more of a struggle than for physically normal gifted people. Those who most perceive the handicap ignore the giftedness. The same person will take in these contradictory messages: "You can surmount all obstacles. You cannot overcome your disability."

Both gifted and handicapped people, of course, have great abilities, and both need understanding and support; they resemble one another as well in suffering from a sense of freakishness. Many people will view either handicapped people or gifted people as freaks. The gifted handicapped person surpasses even these others in being a social oddity. This person—who violates so many social norms—must deal with feeling very different from others, with being isolated socially, and often with enduring ostracism.

A social unicorn, the gifted handicapped person quite likely will deny both being handicapped and being gifted. He or she will learn the sad, erroneous lesson that one must reject oneself as the price of social acceptance.

If our society misunderstands both handicapped and gifted people, it likewise misunderstands why they achieve or fail to achieve. Successful handicapped people succeed, not simply *in spite of* their disability, but also *because of* it. They may "overcome" their handicap, but they never leave it behind. They have it as a companion for life. People who imagine that one can "leave behind" a handicap simply have not comprehended its physical actuality. Nor have they perceived how disability can affect personality. My own powerful drive towards achievement, my will to overcome obstacles, my habit of compensating for any weakness, my very developed ability to concentrate—all these have as their origin my severe disability, and all attest to its having become an integral part of my nature. Deafness, more specifically, probably has engendered my vivid intuition of nonverbal communication of feelings, as well as my habit of finding the incongruous funny. One who sometimes hears what others have not said, after all, often encounters an incongruity between perception and actuality. Far from seeing my disability as incidental, I acknowledge that I might not have achieved as much without its spur.

Perhaps, in contrast, gifted people succeed, not simply *because of* their giftedness, but almost *in spite of* it. Other qualities than giftedness seem necessary for a person to achieve potential. Without the will to succeed or sensitivity to social nuances, for example, giftedness might well effectively bar a person from achievement, or undermine it.

If I were guiding a gifted handicapped child to achieve potential, then, I would see that child's self-acceptance as a handicapped gifted person as crucial. Acceptance of the disability, of oneself as disabled, proves central to achieving self-respect. If disabled people think of themselves as normal and deny their handicap, they are practicing both self-deception and self-rejection because they simply can never be normal. And they are colluding with society's dubious premise that only the normal are acceptable.

For the same reasons, the gifted must accept their giftedness, not deny or exaggerate it. The fantasy of becoming normal will never come true. But self-acceptance can mean increased understanding of the fear and anxiety that perpetuate societal stigmas and of the need to deal more positively with being different, isolated, ostracized.

The disability is a fact. The giftedness is a fact. Neither fact defines a person's entirety. One must put them in proportion to all the other facts about that person.

Self-acceptance does not mean self-defeat. Once one has stopped pretending to be someone one is not, more energy exists to attain all that one can. Though won only with tremendous difficulty, my own self-acceptance at 25 punctured a feeling of fraudulence that had troubled me for years, and it allowed me to mourn the vanished, poisonous fantasy that somehow, if I only worked hard enough at resembling a physically normal person, I would become one. Self-acceptance provides the bedrock for positive change. Self-rejection sabotages change. Achieving possibilities, oddly enough, depends on accepting actualities.

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